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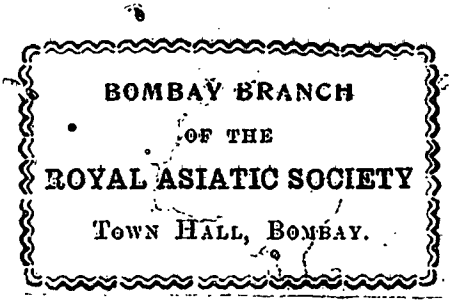

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TRAVELS

IN THE

TWO SICILIES,

AND

SOME PARTS OF THE APENNINES.

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Tranſlated from the Original Italian of the

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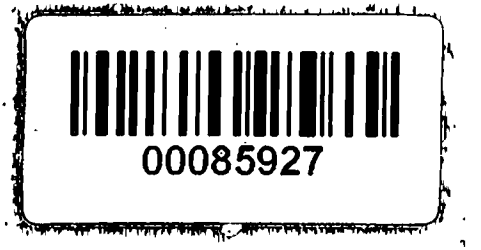
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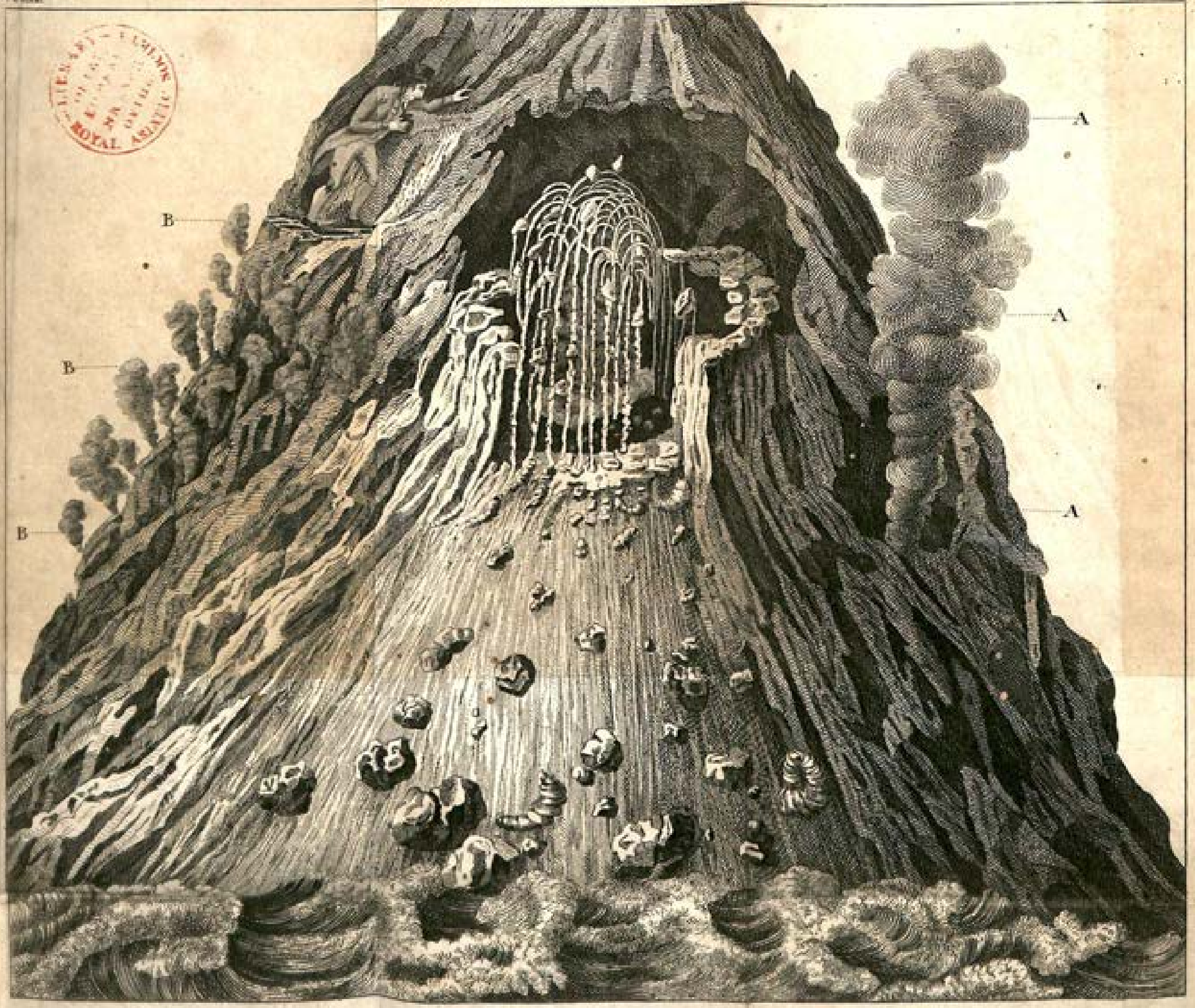

Stromboli

TRAVELS

IN THE

TWO SICILIES, &c.

THE LIPARI ISLANDS.

INTRODUCTION.

The volcanization of theſe iſlands known to the ancients, and ſtudied by ſeveral of the moderns—A wide field for obſervation, nevertheleſs, left to others—Felicuda, and Alicuda, two of theſe iſlands, firſt examined by the author.

THE Lipari Iſlands are ſituated in the Mediterranean, between Sicily and Italy, and are called the Eolian iſles, from Æolus

their reputed king, but more generally the Lipari iſlands, from the name of the principal and largeſt. Though they were anciently known to be volcanic, and therefore were called vulcanian, it is only in modern times that their volcanization has been conſidered as an intereſting object of the reſearches of the philoſopher, who labours to promote the knowledge of nature. M. de Luc, Sir William Hamilton, and the Commendator Dolomieu, in this reſpect, particularly deſerve notice.

The former of theſe naturaliſts, in the year 1757, viſited Volcano, one of theſe iſlands, and made a number of obſervations; eſpecially with reſpect to the principal circumſtances relative to its extenſive crater.

The ſame iſland, as well as that of Stromboli, exerciſed the curioſity of Sir William Hamilton; though he only ſaw it at a diſtance, as he was returning, from Meſſina to Naples, in the year 1768. The accounts

of

of theſe two writers will be related and examined in their reſpective places.

But much more complete and intereſting, relative to volcanic enquiries, is the information we received from the Commendator Dolomieu, in his work entitled *A Voyage to the Lipari Iſlands* *. The field, however, in which he laboured is ſo extenſive and productive, that there is ſtill room for new and abundant harveſts. Theſe iſlands are ten in number, and he remained there only eight days, circumſtances, perhaps, not permitting him a longer ſtay. Some of them, it is true, are very ſmall; yet others would require many weeks to examine them minutely. Among the latter is the iſland of Lipari, which is nineteen and a half Italian miles in circuit.

Theſe conſiderations, therefore, far from cauſing me to abandon my deſign of viſiting and examining theſe countries, rather increaſed my deſire to carry my plan into

* Viaggio alle Iſole di Lipari.

execution; and the work of M. Dolomieu itſelf gave the laſt impulſe to my determination. With a candour worthy of himſelf, he thus concludes his obſervations: "In "the deſcription I have given of the Eolian "iſles, I do not pretend that I have been "able to point out every thing intereſting "which they contain, or entirely exhauſted "the ſubject; I rather hope that I ſhall ex-"cite other travellers, who have more time "at their diſpoſal, to examine them with "attention; in which caſe, I can aſſure them, "they will be rewarded with a much more "abundant harveſt than that I have reaped."

I ſhall conclude with adding that two of theſe iſlands, Felicuda and Alicuda, were not viſited by this naturaliſt; and it was no ſmall gratification to me to recollect that I was the firſt who had examined them. Wherever I have been preceded by M. Dolomieu, I ſhall not fail to notice it to the reader; and, while I relate my own obſervations, ſhall be careful to do juſtice to his diſcoveries.

CHAP.

CHAP. X.

STROMBOLI.

The fires of this volcano viſible, by night, at the diſtance of a hundred miles—Their apparent intermiſſions—Intermiſſions in the ſmoke ſeen by day—Shoals of dolphins met with near this iſland—Appearances obſerved in the ſmoke of the volcano, when ſeen at a ſmall diſtance—Exploſions of the volcano—The alterations in the volcano ſymptoms of the changes of the atmoſphere, according to the opinion of the people of Stromboli—Signs of good and bad weather deduced from theſe alterations—Obſervations on theſe prognoſtics, made by the author, during a ſtay of five-and-thirty days—Phenomena of the volcano obſerved at the diſtance of two miles from the crater—Quality of the aſhes ejected at that time—Quality and origin of the ſand which occupies a conſiderable part of the iſland—

Internal conſtructure of the iſland—Conjectures that the crater of this volcano was anciently at the ſummit of Stromboli—The iſland formed of a ſingle, but bifurcated, mountain—Incontrovertible teſtimonies that, for more than a century, the crater of this volcano has been ſituated towards the middle of the mountain—Error of Sir William Hamilton in placing this crater at the ſummit—The opinion, generally admitted, of the intermiſſions of the conflagration of Stromboli, probably, not well founded—The eruptions at that time much weaker than they frequently are—The declivity of the mountain to the weſt the only place where the ejected matter falls into the ſea—Abſurd reaſon aſſigned by the inhabitants of the Eolian iſles why that part of the ſea into which the ejected matter falls is never filled with volcanic ſubſtances—Explanation of the author—Deſcription of the road up the mountain towards the crater—Height of Stromboli Hot acid-ſulphureous fumes near the ſummit, which have an internal communication with the volcano—

cano—Remains of an ancient crater at the ſummit of Stromboli—Appearance of the ejections ſeen from above—Their perpendicular height—Concluſive proofs that the volcano of Stromboli is not intermittent, as ſome travellers have aſſerted—The cavity of the crater of this volcano probably not very deep—Streams of ſmoke which iſſue from three ſeveral parts of the volcano—The author ſucceeds in an attempt to approach nearer to the crater—Phenomena which he obſerved in conſequence of this nearer approach—Form and ſtructure of the crater—Liquid lava within it—Qualities of that lava—The eruptions of Stromboli little, or not at all, intermittent—Obſervations made by night within the crater itſelf—An unexpected and terrible phenomenon—Its explanation.

THE iſland of Stromboli is diſtant from Sicily fifty miles, and is the firſt of the Eolian iſles to the north-eaſt. It was called Στρογγύλη by the ancient Greeks, from its round figure, and was celebrated for its ex-

traordinary volcano. Etna, Veſuvius, Hecla, and other burning mountains, rage at intervals, and vomit forth torrents of fire, but afterwards relapſe into a total inaction which continues ſeveral years, and ſometimes whole centuries; but the eruptions of Stromboli are continual, though not ſo continual but that, according to the accounts of all the modern travellers, they have ſometimes ſhort periodical intermiſſions.

I ſailed from Naples for Sicily on the 24th of Auguſt 1788; and the next night, having proceeded to a conſiderable diſtance beyond the ſtraits of Capri, I began to diſcover the fires of Stromboli, though at the diſtance of at leaſt a hundred miles. I obſerved a ſudden blaze, which feebly ſtruck my eyes, and after two or three ſeconds diſappeared. After ten or twelve minutes the flame again became viſible, and again diſappeared. I obſerved this phenomenon for ſeveral hours, and it only differed in its longer or ſhorter duration, and the intervals between its appearances. The mariners with

with whom I ſailed teſtified conſiderable joy at the ſight of this fire, as they aſſured me that, were it not for the light it afforded in dark and ſtormy nights, they ſhould frequently be in danger of being ſhipwrecked at ſea, or running on ſhore on the neighbouring coaſt of Calabria.

When day arrived, and we had approached much nearer the volcanic iſland, the light of the ſun prevented the flame from being viſible; but a ſmoke appeared, which had nearly the ſame alternations with the fire, before obſerved. As I was now, however, on my way to Meſſina, with intention to aſcend and examine Mount Etna, I ſoon loſt ſight of the volcano, which I propoſed afterward to viſit, on my return from Sicily, when I ſhould take up my reſidence for a ſhort time in Lipari.

This deſign I carried into execution on the 1ſt of October, taking the advantage of a felucca which was returning to Stromboli. We ſailed early in the morning, a ſtrong ſouth-

ſouth-weſt wind blowing, and ſome clouds floating in the atmoſphere which appeared to threaten a tempeſt. The ſea was rough; but the wind being in our favour, the maſter of the felucca, who was at the ſame time our pilot, encouraged us againſt the fear of any accident, only telling us, in a jocular manner, that *we ſhould have a little dancing.* All the ſails were ſet, and we flew rather than ſailed over the ſurface of the ſea. Though the wind continually increaſed, and the ſea ran higher, ſo that we were ſometimes hanging on the pinnacle of a wave, and again plunged to the bottom of a yawning gulf, we had nothing to fear, as the gale was exactly in our ſtern; and in leſs than three hours we arrived at Stromboli, which is thirty Italian miles from Lipari, and anchored on the north-eaſt ſide of the iſland, where the body of the mountain breaking the force of the wind rendered the ſea ſomewhat more calm.

During a great part of this voyage we were accompanied by a number of fiſh, which appeared

appeared to attend us as an eſcort. Theſe were dolphins, which ſurrounded the ſhip, playing their gambols, and ſpringing ſometimes from the ſtern to the prow, and back again; then ſuddenly plunging under the waves, and as ſuddenly re-appearing, holding up their ſnouts, and throwing up the water to the height of ſeveral feet from the ſpiracles which they have in the head. On this occaſion I obſerved what I had never noticed before in any of the ſmaller fiſh of the cetaceous kind in other ſeas, I mean the incredible ſwiftneſs with which they ſwim and turn in the water. They would frequently dart from the ſtern to the ſtem of the ſhip, and, though they had to encounter the reſiſtance of the agitated waves, fly with the rapidity of an arrow.

But I return to obſervations of another kind, and ſuch as are relative to the principal object of this work.

As we advanced towards Stromboli, which was continually before me, I obſerved that its

its ſummit was covered with a very thick ſmoke, which extended to the brow of the mountain. I landed at nine in the morning; and, eager to gain information relative to the volcano, without delay began to aſcend the mountain, till I arrived at the extreme edge of the ſmoke, which I wiſhed to examine with attention. This ſmoke, to all appearance, perfectly reſembled the clouds. In the lower part it was black and dark, and white and ſhining in the upper; from the former being penetrated with but little of the ſolar light, and the latter with a greater quantity. It was ſo thick that the ſun could not be ſeen through it. The upper part of it ſeparated into a number of globes, and various irregular and unuſual forms, which, according to the motion of the air, aſcended, deſcended, or took a circular courſe, becoming whiter, and more irradiated by the ſun the higher they aroſe; all which appearances are obſervable in the clouds, eſpecially in the time of ſummer. This ſmoke, when it had reached a great height, became ſo thin as to be no longer

diſcernible

diſcernible by the eye. The ſulphureous acid it contained was extremely manifeſt, and ſo inconvenient to reſpiration, that I was obliged to return to the plain, not being able, at that time, to attempt a nearer approach to the volcano, from which dull and hollow exploſions were almoſt continually heard.

The remainder of the day I employed in interrogating the people of the iſland relative to their volcano, it appearing to me that no perſons could give me more information than thoſe who continually had the mountain before their eyes. The following were the accounts I received from them. When the north, or north-weſt winds blow, the ſmoke is little in quantity and white, and the exploſions of the volcano very moderate; whereas the latter are louder and more frequent, and the former much more extenſive, and black, or at leaſt dark, when the ſouth-weſt, ſouth-eaſt, or ſouth winds prevail; and ſhould any one of theſe three winds blow with violence, the ſmoke will ſometimes ſpread

itſelf over the whole iſland, and darken it like heavy clouds in rainy weather. Should this cloud of ſmoke thus extend itſelf when the vines of Stromboli are in leaf, if it remains only a few hours, it will not injure them; but ſhould it continue a whole day, or longer, the grapes will not ripen, or at leaſt the vintage will be leſs productive. The ſmoke conſtantly has the odour of burning ſulphur, and conſequently is very diſagreeable and noxious.

This thick and copious ſmoke, which is commonly accompanied with more violent and frequent eruptions, not only is emitted while the ſouth, ſouth-eaſt, and ſouth-weſt winds blow, but precedes theſe winds ſeveral days. The people of the country are therefore enabled to foretel the winds which will be propitious or adverſe to mariners. They told me that, not unfrequently, veſſels which had anchored at Stromboli during the winter, and propoſed to ſail becauſe the ſea appeared calm and the weather favourable, had been induced

to

to remain longer by the obſervance of theſe prognoſtics, which they had not found deceitful. The knowledge of theſe indications is not, however, the fruit of the modern obſervations of theſe iſlanders: it is extremely ancient *, and has been tranſmitted from the moſt remote ages to the preſent, from generation to generation, and will probably be delivered down in like manner to the lateſt poſterity. Æolus, who is ſaid to have reigned in theſe iſlands, is ſtyled in fable the King of the Winds, probably, as ſome writers have conjectured, becauſe, from the changes in the ſmoke and eruptions of the volcano, he was able to predict what winds would blow.

I ſhall here (if I may be allowed a ſhort digreſſion not unſuitable to my ſubject) relate the obſervations which I made relative to the connection between the phenomena

* Thoſe who wiſh to know the predictions of the ancients, relative to the changes in the air and the ſea, deduced from the ſmoke and fires of Stromboli, may conſult the *Sicilia Antiqua* of Philip Cluverius.

of the atmoſphere and thoſe of the volcano, during the five-and-thirty days which I remained in the Eolian iſles; the ſmoke of Stromboli by day, and the flames by night, being clearly viſible in thoſe iſlands, and the adjacent ſea.

Twice within that time, on the 13th of September, and the 1ſt of October, the *Libeccio*, or ſouth-weſt wind, blew ſtrong. The firſt time no ſenſible change was obſervable in the volcano of Stromboli, though, according to the aſſertion of the people of the iſland, the ſmoke ſhould have collected thicker round the mountain, and the exploſions have become louder. The ſecond time, the appearances approached nearer to thoſe they deſcribe.

The *Scilocco*, or ſouth-eaſt wind, blew three times: on the 21ſt and 26th of September, and the 7th of October. This wind, if we believe the mariners of Stromboli, has a ſimilar effect on their volcano with the ſouth-weſt; and, in fact, on two of

of the above-mentioned days, while this wind blew, the eruptions were ſtronger, and the cloud of ſmoke more extenſive; but the third time theſe effects were not obſervable.

On the contrary, the north wind, which blew on the 11th and 12th of October, and which, according to theſe iſlanders, leaves the volcano at reſt, was preceded and accompanied by exploſions which were heard in the other iſlands, and by a large cloud of ſmoke which covered the half of Stromboli, and roſe with a white edge, like that we ſometimes obſerve in tempeſtuous clouds.

I muſt add, that, ſometimes, though not a breath of wind blew, the eruptions were very copious, and the ſmoke was extremely thick.

Theſe obſervations render me not much inclined to receive implicitly all that the people of Stromboli ſo poſitively aſſert relative to their volcano; and the leſs, ſince

the mariners of the other Eolian iſles are of a different opinion. When I was at Felicuda, where the eruptions of Stromboli may be very clearly ſeen by night, thoſe eruptions were very ſtrong, and almoſt continual, and every one was followed by an exploſion, which might be very diſtinctly heard in that iſland. I turned to one of the mariners of Felicuda, who ſtood near me, and aſked him what he thought of the prognoſtics of that volcano. He returned me the following brief ſententious anſwer: *Stromboli non fa marinaro*, Stromboli will not make a ſeaman. To determine, however, with certainty, whether there are any direct and immediate relations between the changes of the atmoſphere and thoſe of Stromboli, and what thoſe relations are, would require a ſeries of obſervations for ſeveral years, made on the ſpot by ſome intelligent and unprejudiced naturaliſt; and theſe we certainly have not.

I ſhall now proceed to relate what I obſerved

ſerved relative to the volcano on the night of the 1ſt of October. My reſidence was in a cottage, on the north ſide of the iſland, about half a mile from the ſea, and two miles from the volcano; but ſo ſituated that the cloud of ſmoke round the mountain ſcarcely permitted me to ſee the top of the fiery ejections. I employed more hours of the night in making my obſervations, than I permitted myſelf for repoſe; and the following is a brief ſummary of the principal appearances I noticed.

The ſouth-eaſt wind blew ſtrong. The ſky, which was clear, the moon not ſhining, exhibited the appearance of a beautiful aurora borealis over that part of the mountain where the volcano is ſituated, and which, from time to time, became more red and brilliant, when the ignited ſtones were thrown to a greater height from the top of the mountain. The fiery ſhowers were then more copious, and the exploſions which followed them louder, the ſtrongeſt reſembling thoſe of a large mine which

does not ſucceed properly, from ſome cleft or vent. Every exploſion, however, ſlightly ſhook the houſe in which I was, and the degree of the ſhock was proportionate to the loudneſs of the ſound. I do not believe that theſe ſhocks were of the nature of the earthquake; they were certainly to be aſcribed to the ſudden action of the fiery ejections on the air, which ſtruck the ſmall houſe in which I was, in the ſame manner as the diſcharge of a cannon will ſhake the windows of the neighbouring houſes, and ſometimes the houſes themſelves. A proof of this is, that the fiery ſhowers always were ſeen a few ſeconds before the ſhock was felt, whereas the houſe was ſo near the volcano, that, had it been a real earthquake, no interval of time would have been perceptible.

Before the morning roſe, the fiery light over the volcano increaſed ſo much, at three different times, that it illuminated the whole iſland, and a part of the ſea. This light was each time but of ſhort duration, and

the

the ſhowers of ignited ſtones were, while it laſted, more copious than before.

On the morning of the 2d of the ſame month, the ſouth-eaſt wind blew ſtronger than ever, and the ſea was greatly agitated. The ſmoke of Stromboli formed a kind of cap round the top of the mountain, which deſcended much lower than on the preceding day. The phenomena were the ſame; but the convulſions of the volcano were more violent. The exploſions were very frequent, but always with a hollow ſound; and the ejected aſhes reached the ſcattered dwellings of the people of the iſland. In the morning, the ground appeared very plentifully ſprinkled with theſe aſhes, as they are called by the natives; but on examination, I found that they were not properly aſhes, but very finely triturated ſcoriæ, conſiſting of very ſmall grains, of no determinate form, dry, and rough to the touch, and which crumble into powder under the finger. They are not very far from a vitreous nature, in colour between a grey

and a red, ſemi-tranſparent, and ſo light, that ſome will float on the water. Their levity proceeds from the great quantity of veſicles, or pores, which they contain, and which cauſes them, when viewed with the lens, to bear ſome reſemblance to the ſea production of unknown origin called favago (*favaggine*).

The iſlanders aſſured me that theſe eruptions were very inconſiderable, compared with others which had formerly taken place, during which the aſhes had, in a few hours, formed a covering over the ground and the houſes of ſeveral inches thick; and the ſtones thrown out were ſcattered over the whole iſland, to the great damage of the vineyards and woods which were near the volcano, to which the flames communicated *.

As

* Theſe ſhowers of ſand and pulverized ſcoriæ ſeem to be inſeparable from volcanic eruptions, and to be copious in proportion as the latter are violent. Of this we have an example in the eruption of Etna

in

As the day advanced, the hope I had entertained that I ſhould be able immediately to viſit the volcanic fires of Stromboli, greatly diminiſhed; ſince I muſt have had to paſs a large tract of the mountain entirely covered with ſmoke, which had extended itſelf ſo widely through the air, that it darkened the whole iſland. I deferred, therefore, my intended journey till the next day, ſhould that prove more favourable, and employed myſelf in examining the principal productions of the place.

Wherever I placed my foot, I found the whole ſhore, to the eaſt and north-eaſt, compoſed of a black volcanic ſand. This ſand is an aggregate of fragments of ſhoerls, as has been remarked by M. Dolomieu; but when we view it with the lens, we diſcover,

in 1787 (ſee vol. i. chap. vii.) when the ſand was carried as far as Malta. How great a ſpace was covered by the ſand ejected from Etna, in the eruption of 1669, has been already noticed. There is likewiſe no eruption of Veſuvius which is not accompanied by ſimilar ſhowers of ſand and aſhes.

beſides the ſhoerls, which are entirely opake, and are attracted by the magnet, a number of ſmall tranſparent and vitreous bodies, of a yellowiſh green tincture, and which are inſenſible to the magnet. I was doubtful whether theſe were likewiſe fragments of ſhoerls, but of a different ſpecies, or whether they were volcanic chryſolites; their extreme minuteneſs not permitting me to aſcertain their nature by any ſatisfactory experiment.

This ſand extends into the ſea, to the diſtance of more than a mile from the ſhore; as appeared from its adhering to the ſunken plummet, when it had been previouſly covered with tallow: probably it reaches to a ſtill greater diſtance.

The ſea eaſily penetrates through this ſand; for if any part of the ſhore be dug into a little depth, ſea water is found, but rendered ſomewhat more freſh by having left a part of its ſalts in the ſand; as happens to the ſame water when it iſſues, drop by drop, through a long tube filled with ſand, through

which

which it is filtred. The fiſhermen of Stromboli, when they are in want of freſh water, frequently dig wells on the ſhore, and drink the water theſe afford.

This ſand, as has been already ſaid, occupies that part of the iſland which fronts the eaſt, and the north-eaſt, extending on the one ſide to the ſea, into which it ſtretches, and on the other to the ſummit of the mountain. It owes its origin partly to the immediate ejections of it by the volcano, and partly to the pieces of ſcoriaceous lava thrown out by the ſame, which being, as has been ſaid, extremely friable, and greatly abounding in ſhoerls, eaſily decompoſe and become pulverized in this ſandy matter. In fact, nothing is more uſual than to find in it fragments of this ſcoriaceous lava, of various ſizes. This ſand is found principally near the volcano, where both it, and the ſcoriaceous lavas from which it is formed, fall in the greateſt quantities; but as, from its fineneſs, it is eaſily moveable, it is

carried by the wind to the vallyes and lower grounds quite to the ſea.

This, however, is only the thin upper coating of thoſe parts of Stromboli which it covers, as under it lies the firm texture of the iſland; I mean the ſolid lavas, which are viſible on ſeveral ſteep deſcents, that have been ſtripped of the ſand, either by the action of the rain-water, or that of the winds.

On the ſame day I made the circuit of a great part of the baſe of the iſland, which is about nine miles in circumference, and found the ſame ſolid conſtructure; a ſmall tract of tufa, on the north ſide, excepted, which deſcends to the ſea.

In this excurſion, I carefully examined the courſe and direction of the lavas, and was convinced that they all had flowed from the ſteepeſt ſummit of the mountain, under different angles of inclination, paſſing one over

over another, and thus forming a ſucceſſion of cruſts, or ſtrata, like, in ſome meaſure, the coatings of which an onion conſiſts. In ſeveral places where the lava has entered the ſea, theſe cruſts may be ſeen lying one over the other, ſome of them broken or ſeparated by the ſhock of the waves.

Theſe facts ſtrongly induced me to ſuſpect that the crater of Stromboli had anciently been ſituated on the ſummit of the mountain, and that the lavas which had principally contributed to the production of the iſland had flowed from that crater.

On the ſides of Etna and Veſuvius, mountains of an inferior order ariſe, which likewiſe owe their origin to fire: Stromboli, on the contrary, is entirely a ſingle mountain, except that its top is divided into two ſummits. Hence it appears that there have been none of thoſe eruptions in its ſides, which generate leſſer mountains, or hills, of a conical form.

But this crater, which I conjecture, and ſhall hereafter prove, actually to have exiſted, has long ſince given place to that which at preſent burns. Among the various enquiries which I made of the inhabitants of Stromboli, I interrogated them with reſpect to the preciſe ſituation, in former times, as far as they had heard or could remember, of that burning gulph which throws out fire and red-hot ſtones; and they all agreed in aſſuring me that they had never known it in any other place but that in which it now is, that is to ſay, about half way up the mountain.

I lodged with a prieſt who was now approaching the decline of life, who not only confirmed this account, but adduced the authority of his father, who had died at the age of eighty, and who had told him that he had heard, from perſons older than himſelf, that in their time the ſituation of the burning furnace was the ſame as at preſent.

About

About a mile from the mouth of the volcano, lives a peaſant, who from his cottage can diſtinctly ſee every burning eruption; and though he frequently feels no little alarm, when the fragments of lava are thrown quite to his doors, and the fire reaches his little vineyard, yet, from long habit, and love for the place of his birth, he ſtill continues to reſide there. When I aſked this man what was the ſituation of the burning cavern in former times, he returned me the ſame anſwer I had received before; alleging, in confirmation of its truth, the teſtimony of his anceſtors who had reſided on the ſame ſpot. And as to the ſhowers of ejected matter, all of whom I enquired unanimouſly aſſured me that they had always ſeen them ſuch as they at preſent appear, except that they might be ſometimes ſtronger and ſometimes weaker.

All theſe teſtimonies appear ſufficiently to prove that the volcano of Stromboli has burned for more than a century where it now

now burns, without any ſenſible change having taken place in its ſituation.

I ſhall here make a few remarks on the account which Sir William Hamilton has given us of Stromboli, agreeably to my promiſe in the introduction to this volume.

He tells us, that on his return from Meſſina to Naples he met with a calm, while among the Lipari iſlands, which laſted three days. "Hence," ſays he, "I had an opportunity clearly to aſcertain that all theſe "iſlands have been formed by eruptions. "That which is called Volcano, is in the "ſame ſtate in which Solfatara now is. "Stromboli is a volcano which has preſerved "its vigour entire, and conſequently a form "more pyramidal than the reſt of the iſlands. "We frequently ſaw burning ſtones thrown "from its crater, and lava iſſuing from the "ſides of the mountain, flow down into the "ſea."

This

This deſcription is accompanied by a plate which is the thirty-ſeventh plate of the Campi Phlegræi, and repreſents the mountain of Stromboli. In it the crater is repreſented at the ſummit, throwing out flames and ignited ſtones; and on the ſides are ſeen ſtreams of liquid lava deſcending into the ſea. That the obſervations of this reſpectable naturaliſt on volcanos merit the moſt attentive conſideration, the work I have cited furniſhes numerous and inconteſtable proofs: that impartiality, however, which ought to be inſeparable from philoſophy, compels me to declare that what he has ſaid of this mountain is not exactly conſonant to fact. From the time of his obſervations to that of mine, only twenty years have elapſed. If, therefore, the crater of Stromboli had, then, been at the ſummit of the mountain, and had it thrown out thence its ſhowers of fiery matter, the inhabitants of the iſland would ſurely have remembered the fact when I was there: but when I told them that, twenty years before, the burning gulph of their mountain was not ſituated

half

half way up its ſide, but at the top; they all poſitively aſſerted that this muſt be a miſtake.

The ſame they affirmed of the aſſertion that lava had iſſued from the ſides of the mountain, and flowed down into the ſea; when, to hear their anſwer, I told them that this had been obſerved at the ſame time. Indeed, it ſeems very extraordinary, that I ſhould never have met with any traces of theſe currents of lava, though I ſo carefully examined the iſland.

I am of opinion, that Sir William fell into theſe errors from not having landed at Stromboli, but only viewed it at ſea, at a diſtance, where he might eaſily be deceived by ſome illuſion of ſight. In fact, had he landed, it is not to be doubted, but he would have mentioned it. That he made his obſervations at ſome diſtance from the iſland, is ſufficiently indicated by theſe words: "Stromboli is a volcano which has "preſerved a form more pyramidal than

"the

" the reſt of the iſlands." When Stromboli is ſeen at a diſtance it certainly appears of this pyramidal, or, more properly, conical form, much more than when ſeen near; for then it appears bifurcated, nearly ſimilar to Monte Roſſo, on one of the ſides of Mount Etna.

"

The diſtance has likewiſe rendered him inaccurate relative to the iſland of Volcano. Had he landed there, and examined the place, he would not have compared it to Solfatara. We ſhall ſee in Chap. XIV. of this Work, the difference of the ſtates of the two volcanos.

The figure, more or leſs conical, of the Eolian iſles, as ſeen from the ſea, while Sir William ſailed among them, the ſmoke which he ſaw riſe from ſome, and the fiery eruptions of others, ſuggeſted to him, I imagine, the idea that " they have all been " formed by eruptions;" as he has not adduced a ſingle local fact in ſupport of that opinion.

On the 2d of October I made the obſervations I have already related, at the foot, and the lower part of the ſides of Stromboli. The following night the volcano exhibited phenomena ſimilar to thoſe of the preceding, and the next day (the 3d) proved favourable to my wiſhes to approach nearer to the burning crater. It now ſmoked but little, and only a few exploſions, and thoſe ſcarcely audible, were heard. The ſky was free from clouds, and the ſea calm.

The crater may be approached by two ſeveral ways; either by taking a boat, and obſerving it from the ſea; or by land, paſſing the top of the mountain, and proceeding as near as poſſible to the edges of the crater. I reſolved to obſerve it, firſt, from the water, taking advantage of the calm which then prevailed; as I well knew how frequently that ſea is violently agitated by tempeſtuous winds.

After having coaſted the iſland the diſtance of three miles and a half towards the north,

north, I arrived oppoſite the place where the ſhowers of ignited matter fall into the ſea. The ſide of the mountain is here a ſteep declivity, almoſt perpendicular, about half a mile broad at the bottom, and a full mile long, terminating above in a point, and forming an iſoſceles triangle, the baſe of which is waſhed by the ſea. The apex of the triangle is at the brink of the crater. Before I reached the ſteep declivity, I obſerved a great cloud of duſt extending along it, of which I could not aſſign the origin; but on a nearer approach I diſcovered the ſecret. It was evidently produced by pieces of lava, of various ſizes, which rolled down, and, in their deſcent, raiſed the fine ſand with which this declivity is covered.

While I was intently obſerving this object, the mountain ſuddenly made an exploſion. A quantity of pieces of lava, of a dark-red colour, enveloped in ſmoke, were ejected from the top of the precipice, and thrown high into the air. A part of them

fell again upon the declivity, and rolled headlong down, the ſmaller preceded by the greater, which, after a few long bounds, daſhed into the ſea, and, on entering the waves, gave that ſharp hiſſing ſound which, in a leſſer degree, is produced by a bar of red-hot iron which a ſmith plunges in the water. The leſſer fragments of lava followed, but, from their lightneſs and the hindrance of the ſand, rolled ſlowly down the declivity, which was then obſcured by a ſmall cloud of duſt; and ſtriking againſt each other produced nearly the ſame ſound as is occaſioned by large hailſtones falling on the roofs of houſes. In a few moments after, another exploſion followed; but this was a ſmall one, without any ſenſible noiſe, and the few pieces of lava that were thrown up, roſe to but a ſmall height, and fell back into the crater. Two minutes after, a third eruption took place, with a much louder exploſion than the firſt, and a far more copious ejection of lava. The eruptions which I afterwards obſerved, and which

were

were innumerable in the ſpace of three hours, that I continued there, exhibited the ſame appearances.

Theſe obſervations cauſed me to doubt of the truth of an opinion to which I had inclined before my arrival in the iſland. I mean the periodical intermiſſions which travellers aſcribe to the éruptions of Stromboli; and which I ſuppoſed I had obſerved, in the night, in my voyage from Naples to Sicily. When from the bottom of this precipice I had the volcano and its fiery hail before my eyes, I do not, indeed, mean to affirm that it continually raged and thundered equally; but the intermiſſions between its ejections were ſo ſhort that they rarely exceeded three minutes, though by the accounts of theſe travellers they are conſiderably longer. Yet was I willing ſtill to ſuſpend my judgment, until I ſhould have had a nearer view of the crater, on the mountain itſelf.

The following night I returned to the

 ſame

ſame place, perſuaded that I ſhould ſee new objects to excite my admiration; and in fact, the ſcene I beheld, appeared to me as delightful and aſtoniſhing, as it was noble and majeſtic. The volcano raged with more violent eruptions, and rapidly hurled to a great height thouſands of red-hot ſtones, forming diverging rays in the air. Thoſe which fell upon the precipice, and rolled down it, produced a hail of ſtreaming fire, which illuminated and embelliſhed the ſteep deſcent, and diffuſed itſelf around through a conſiderable ſpace.

But, independent of theſe ignited ſtones, I remarked a vivid light in the air, which hovered over the volcano, and was not diminiſhed when that was at reſt. It was not properly flame, but real light reverberated by the atmoſphere, impregnated by extraneous particles, and eſpecially by the aſcending ſmoke. Beſides varying in its intenſity, it appeared conſtantly in motion, aſcended, deſcended, dilated, and contracted, but conſtantly continued fixed to one place,

place, that is, over the mouth of the volcano; and clearly ſhewed that it was cauſed by the conflagration within the crater.

The detonations, in the greater eruptions, reſembled the diſtant roar of thunder; in the more moderate the exploſion of a mine; and, in the leaſt, they were ſcarcely audible. Every detonation was ſome ſeconds later than the ejection. This, likewiſe, was obſervable by day.

I remained that night two hours on the water at this place, and the eruptions were ſo frequent, and with ſuch ſhort intermiſſions that they might be ſaid to be continual.

During both theſe viſits, thick ſhowers of ſand and fine ſcoriæ fell into the ſea, and falling on my hat, which was of oil-cloth, made a noiſe like a ſmall hail.

The five ſailors who had the care of the boat in which I was, and ſome other natives of Stromboli who were with me, and whoſe

occupation frequently brought them to that part of the ſea, told me that the volcano might now be conſidered as very quiet; aſſuring me, that, in its greater fits of fury, red-hot ſtones were frequently thrown to the diſtance of a mile from the ſhore, and that, conſequently, at ſuch times, it was impoſſible to remain with a boat ſo near the mountain as we then were. Their aſſertion appeared to me ſufficiently proved by a compariſon of the ſize of the fragments thrown out in the exploſions I now witneſſed, with that of thoſe which had been ejected in ſeveral former eruptions. The firſt (many of which had been ſtopped at the bottom of the precipice by other pieces of lava, and were ſcoriaceous lavas, approaching to a globoſe form) were not more than three feet in diameter; but many of the fragments thrown out at other times, of ſimilar quality to them, and which lay in large heaps on the ſhore, were ſome four ſome five feet in diameter, and others even ſtill larger.

Travellers

Travellers have generally aſſerted that the volcano of Stromboli has for a long time diſcharged its fury into the ſea, without cauſing either alarm or injury to the inhabitants of the iſland. The eruptions, however, fall equally on every ſide around the volcano; though at this place they only fall into the ſea, and in that ſenſe their aſſertion is well-founded.

But the people of Stromboli, and indeed almoſt all the inhabitants of the Eolian iſlands, entertain an opinion, equally amuſing and paradoxical, by which they explain why that part of the ſea which is contiguous to the precipice is never filled up, notwithſtanding the immenſe quantities of ſtones which have been continually falling into it from time immemorial; where, inſtead of a peninſula having been formed by thoſe ſtones, as might naturally have been expected, the ſea is generally ſaid to have no bottom. To explain this apparent paradox, theſe good folks affirm, with the moſt entire conviction that what they ſay is true,

that

that the ſtones of the volcano which fall into the ſea are attracted again by the mountain through ſecret paſſages; ſo that there is a conſtant circulation from the volcano to the ſea, and the ſea to the volcano.

I did not attempt to controvert their favourite hypotheſis, which would have been to no advantage, and to no avail; but I cauſed that part of the ſea to be ſounded, and found it a hundred and twenty-four feet deep, which, though that is not a great depth in the Mediterranean, is certainly, in this place, ſomewhat ſurpriſing; as it was rather to be expected that the continual diſcharge of ſtones into it ſhould have produced a little hill, which would at laſt have emerged above the waves.

Thinking this an object deſerving ſome enquiry, I determined to make my obſervations on the ſpot, and I flatter myſelf I have diſcovered the true explanation of the difficulty. The ſtones which have formerly been thrown into the ſea by Stromboli, and

thoſe

thoſe which that volcano ſtill continues to eject, are of the ſame kind; that is, as I have already ſaid, ſcoriaceous lava. Theſe, from their being porous and little cohering in their internal ſtructure, eaſily crumble, and are converted into ſand, as is ſeen on the eaſt and north-eaſt parts of the iſlands; and this ſeparation of parts is produced by the ſimple action of the elements of air and water, and the rolling of the pieces over each other in their deſcent. A ſimilar trituration is effected at the place where the lava falls into the ſea. The ſteep deſcent I have ſo frequently mentioned is covered with this pulverized lava quite to the ſea ſhore. A part, therefore, of the ſcoriæ is already reduced to powder before it touches the water; and the remainder, which falls into the ſea in whole pieces, muſt ſoon undergo the ſame trituration, from the action of the waves which beat ſo violently in various directions.

I muſt here repeat that the ſea which ſurrounds the iſlands of Lipari, and eſpecially that part of it which waſhes Stromboli, is

ſubject

ſubject to very frequent and very violent ſtorms. The two times that I obſerved the volcano from the ſea, near the precipice, though it was what the ſailors called a perfect calm, our boat was ſo toſſed that it was neceſſary to make uſe of the oars to prevent its being carried from the place. This agitation of the water, likewiſe, extends, here, to a conſiderable depth; as is ſufficiently proved by ſeveral obſervations. The inhabitants of Stromboli, beſides nets, make uſe of weels, or a kind of wicker traps, to catch fiſh. Into theſe they put ſtones, and ſink them to the bottom, leaving a ſort of floating buoy to point out where they lie; but to prevent their being carried away by the waves, in a ſtorm, it is neceſſary that they ſhould be ſunk to the depth of a hundred and forty feet; otherwiſe they would be daſhed againſt the rocks under the water, and loſt. As the depth, therefore, of that part of the ſea into which the ſcoriæ fall is leſs than this, that is, only a hundred and twenty-four feet, they muſt, by the ſhocks of the tempeſtuous waves, no doubt, be

ſoon

ſoon broken, reduced to ſand, and carried away by the violence of the current. It is not, therefore, ſo extraordinary, as it may at firſt view appear, that this part of the ſea ſhould be ſcarcely ever filled by the ſcoriaceous lava which is continually falling into it.

I have ſaid, *ſcarcely ever*, becauſe I was told, by ſome of the people of Stromboli, that about forty-four years ago the volcano threw out ſuch an immenſe quantity of ſcoriæ, that it cauſed a dry place, to uſe their expreſſion, in the ſea. A kind of hill roſe above the waters, which remained from March to the following July, when it gradually diminiſhed, by the action of the waves, and at laſt diſappeared. The hill was formed preciſely in that place where, according to the popular report, the ſea has no bottom. This fact not only is agreeable to the hypotheſis I have offered, but is a ſtrong confirmation of its truth.

The obſervations I had been able to make

on

on the volcano from the ſea appeared to me intereſting and inſtructive; but I flattered myſelf that more of its ſecrets would be revealed to me, if I made a nearer viſit to it, over the mountain itſelf. The way thither lay on the eaſt ſide of the iſland, it being impoſſible to approach it from the ſea, both from the inceſſant ſhowers of heated ſtones, and the inſuperable precipices on both ſides of the ſteep and almoſt perpendicular declivity. I began this journey on the 4th of October, and was much encouraged by the ſtate of the volcano, to hope I ſhould ſucceed according to my wiſhes, as ſcarcely a ſhade of ſmoke covered the higheſt points of the iſland. To arrive there it was neceſſary to make a journey of a mile and a half, reckoning from the ſea-ſhore. The firſt mile is not diſagreeable, but the remainder of the way, though not dangerous, is very difficult; both from the extreme ſteepneſs of the aſcent, from the impediment of the ſand, in which the leg ſinks almoſt up to the knee at every ſtep, and from the looſe and moveable ſcoriæ, which render the

ſummit of the mountain extremely rugged and ſlippery.

Having reached this ſummit, I found myſelf on one of the two points which render Stromboli bifurcated, though, when viewed at a diſtance, it appears conical. This ſummit is ſituated to the north-eaſt: the other, which is ſomewhat higher, inclines to the ſouth-weſt. As nearly as I could eſtimate it, the altitude of the latter above the ſea was about a mile.

To paſs from one ſummit to the other, we go over an extenſive plain, which appeared to me to deſerve the moſt attentive examination. We firſt obſerve white fumes, which ariſe from five apertures, not very diſtant from each other. Theſe fumes have a ſtrong ſulphureous odour, and, gliding along the ground, are inſufferable from their extreme heat. The five apertures appear ſprinkled over with ſmall cryſtals of ſulphur, and muriate of ammoniac (ſal-ammoniac). The ground here is a mixture of ſand and

coriæ;

ſcoriæ; and the ſand, as well below as on the ſurface, is moiſt, which may ariſe from two cauſes, either from the ſubterraneous waters being raiſed in vapour by the volcanic fire, as water conſtantly accompanies burning volcanos; or from the union of the acid of ſulphur with the humidity of the atmoſphere.

The ground in the vicinity of theſe fumes is very hot; and wherever a hole is made with a ſtick, a new ſtream of ſmoke ariſes, which is not fugitive but durable. If you ſtamp with the foot, a feeble kind of echoing ſound is heard, which I do not imagine to be occaſioned by any ſubjacent gulf or abyſs, but only from the very looſe contexture of the ground, which is only compoſed of ſand and very porous ſcoriæ; in the ſame manner as in ſeveral parts of the Apennines, where the ground is light and looſe, I have heard the ſame kind of ſound on ſtamping with the foot. I am, therefore, of opinion, that this hot fuming ground has a communication with the volcano, by nar-

row winding cavities which afford a paſſage to the vapours.

Proceeding to the weſt, over the plain which extends between the two ſummits, another object arreſts ſtill more the attention of the obſerver. The ſummits themſelves have no crater, nor any veſtiges of one; but theſe veſtiges are ſufficiently evident on the ſides of the plain; which here ſinks into a cavity, which may be about three hundred feet in length, from eaſt to weſt, above two hundred in breadth, and one hundred and ſixty in depth. The bottom is covered with ſand and ſcoriæ, not of a very ancient date, but the produce of the ejections of the preſent volcano. The internal ſides of the cavity, however, are not of theſe materials; they are formed of ſtratas of laya which bear the moſt evident marks of the higheſt antiquity. I am, therefore, of opinion that this was the firſt and largeſt volcano of Stromboli, which formed the contexture of the iſland by its lavas, and which, in a great degree, had

been filled up and deſtroyed by the earthy depoſitions of the rain-waters, the matter ejected into it by the preſent volcano, and, perhaps, by the falling in of its own ſides. This opinion is confirmed by the direction of the lavas, all of which appear to have deſcended from the centre of the ſummit; and this direction, when I examined the lower parts of the iſland, induced me to conjecture that the principal volcano had formerly exiſted on the ſummit.

Theſe remains of an ancient crater lie between two points of the mountain which were probably formed when the lava guſhed forth, in the ſame manner as the volcano of Monte Roſſo formed two diſtinct hills. The bottom of this higher and more ancient crater of Stromboli, in two places, emits fumes, which do not differ in their quality from thoſe that have been mentioned above.

From theſe two ſummits the ejections of the preſent crater are diſtinctly obſervable,

as it is not diſtant more than half a mile to the north; and we there evidently perceive that it lies about half way up the mountain, the edges obſcurely projecting, and forming a cliff. Here I was better able, than on the ſea, to eſtimate, by the eye, the height to which the ejected matter aſcends; and can affirm that, in the more violent eruptions, it riſes to the height of half a mile, or even higher, as many of the ignited ſtones were thrown above the higheſt ſummit of the mountain. They did not, however, reach me, but fell, partly on the precipice which deſcends to the ſea, and partly into, and around, the crater. The ejections, indeed, which I call the moſt violent, were, certainly, very moderate, compared with thoſe which the two natives of Stromboli who ſerved me as guides, aſſured me they had witneſſed, at other times, from that ſummit, when, as they ſaid, we ſhould not have been ſafe at the diſtance and height at which we were; and the numerous ſcoriæ around us, the produce of former eruptions, fully confirmed the truth of what

they aſſerted. They likewiſe deſerved attention when they affirmed that, at thoſe times, the ſtones were thrown to more than a mile in height.

From the ſummit of Stromboli I deſcended about a quarter of a mile down the mountain towards the volcano, and took my ſtation on an eminence where I had a much more diſtinct view of the crater, and every eruption; and was more than ever convinced, that the intermiſſions which have been ſo frequently and poſitively aſcribed to it do not exiſt. The exploſions ſucceeded each other with ſuch rapidity, that there was rarely the interval of three or four minutes between any two. They, however, differed greatly in their ſtrength, which has probably occaſioned the miſtake of travellers relative to the intermiſſions of Stromboli. The higheſt ejections, as I have already ſaid, did not riſe leſs than half a mile in height; while the loweſt did not reach the height of fifty feet, and the matter fell back into the crater. Between the

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greateſt and the leaſt, there were ejections without number; and the intenſity of the ſound correſponded to the quality of the ejection. At a conſiderable diſtance from the volcano the moderate and ſmaller eruptions, with their accompanying detonations, were not perceptible, but the greater only; which, not being ſo frequent, may eaſily induce us to form the falſe opinion that this burning mountain has conſiderable intervals of repoſe. But when we approach nearer, we diſtinctly perceive the difference of the ejections, and the error of ſuch a ſuppoſition. Nor can the fact I obſerved be conſidered as accidental, ſince the two guides I took with me, who are accuſtomed to conduct ſtrangers to this place, as well as other natives of Stromboli, who frequently paſs that way to cut wood, all agreed that the eruptions of this volcano are continual, though they are ſometimes ſtronger and ſometimes weaker.

At a diſtance, there was a very perceptible interval between the appearance of the

eruption and the detonation; but here, the difference of time between them was ſcarcely any. The fragments of lava, as they flew, produced a hiſſing ſound; and many of them acquired in the air a globoſe figure, an evident proof of their fluidity; but before they came to the ground, they were hardened, retaining the ſame figure, while they bounded down the cliffs and precipice. From the little eminence on which I ſtood, I could, in part, diſcover the internal ſides of the crater, though I could not ſee far into it; but appearances ſeemed to indicate that it could not be very deep; for, attentively obſerving the fragments of lava that fell again immediately into the crater, I remarked, that almoſt as ſoon as they had entered it I heard the ſound produced by their colliſion againſt the ſubſtance on which they fell. This ſound reſembled that which would be cauſed ſhould water, or rather ſome denſer fluid, be ſtruck with a number of ſtaves or poles. But of this phenomenon, and others more deſerving notice, I ſhall treat, preſently, more

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at length, when I come to ſpeak of other ſecrets of the volcano which were diſcloſed by a nearer approach.

Here it is proper to notice the fumes which exhale from this mountain, as they have an immediate relation to the volcano. Though when I obſerved them from the ſea, they appeared to me of little importance, when I ſaw them from the ſummit and body of the mountain they exhibited a thick cloud, ſeveral miles in length, exhaling a ſtrong ſmell of ſulphur, which, however, was not incommodious to me, as they were raiſed ſeveral poles above the ſurface of the ground. This cloud entirely obſcured the ſun, was black in the middle, but whitiſh at the edges, and more or leſs clear according to the different inclinations, refrangencies, and reflections of the light. It appeared to me that this immenſe maſs of ſmoke extended more than a mile in height. Though it continually iſſued in a conſiderable quantity, its volume did not increaſe, ſince as much was diſſipated in the upper regions of the air, as roſe

from the earth. It derived its origin from a threefold ſource. Firſt, as often as the crater threw up ſtones, a cloud of grey ſmoke immediately aroſe, which was thick in proportion as the ejection was violent and copious. Secondly, to the weſt of the crater, and at a little diſtance from it, are ſome obſcure apertures, through which ariſe, like white clouds, not leſs than a hundred and fifty ſtreams of ſmoke, which, though they are diſtinct at firſt, mingle as they riſe, and form one cloud.

Laſtly, to the eaſt of the crater, there is a large and deep cavern from which aſcends a column of dark and very thick ſmoke, about twelve feet in diameter, which, at that time, from the ſtillneſs of the air, aroſe perpendicularly, moving in large circles through a conſiderable ſpace, and afterwards inſenſibly rarefying as it removed to a diſtance. This cavern, while I was there, threw out no ſtones, nor had it ever been known to do ſo, as my guides aſſured me, though it had always emitted a prodigious quantity of

ſmoke.

ſmoke. The cauſes, therefore, of this ſmoky cloud were theſe three, of which the firſt and third are continual, and the ſecond acts as often as the crater ejects its burning matter: nor can there be any doubt that they are all three connected with the volcanic gulph; which makes its greateſt diſcharge from the mouth of the crater, and a much ſmaller from each of the ſides.

Not ſatisfied with the obſervations I had already made, my curioſity impelled me to attempt further diſcoveries. From the pointed rock on which I ſtood, I could only ſee the edges of the inſide of the crater. I conſidered, therefore, whether it might not be poſſible to obtain a ſight of the lower parts likewiſe; and, looking round me, I perceived a ſmall cavern, hollowed in the rock, very near the gulph of the volcano, into which the rock above prevented the entrance of any burning ſtones, ſhould they be thrown ſo far. It was likewiſe ſo elevated, that from it the crater was open to my view. I therefore haſtened to take my ſtation in

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this cavity, taking advantage of one of the very ſhort intervals between the eruptions. To my great ſatisfaction, my expectations were completely fulfilled; I could here look down into the very bowels of the volcano; and Truth and Nature ſtood, as it were, unveiled before me. The following is the deſcription of the objects which preſented themſelves to my wondering eyes.

The edges of the crater, which is of a circular form, and not more than three hundred and forty feet in circumference, are compoſed of a confuſed mixture of lavas, ſcoriæ, and ſand. The internal ſides contract as they deſcend, and aſſume the ſhape of a truncated inverted cone. Theſe ſides, from the eaſt to the ſouth, have only a gentle declivity, but in the other parts, they are very ſteep. In many places, they appeared incruſted over with yellow ſubſtances, which I imagine to be the muriate of ammoniac (ſal ammoniac) or ſulphur.

The crater, to a certain height, is filled with a liquid

a liquid red-hot matter, reſembling melted braſs, and which is the fluid lava. This lava appeared to be agitated by two diſtinct motions; the one inteſtine, whirling, and tumultuous; and the other, that by which it is impelled upwards. This motion in particular merited to be examined with attention. The liquid matter is raiſed, ſometimes with more and ſometimes with leſs rapidity, within the crater, and when it has reached the diſtance of twenty-five or thirty feet, from the upper edge, a ſound is heard not unlike a very ſhort clap of thunder; while, at the ſame moment, a portion of the lava, ſeparated into a thouſand pieces, is thrown up, with indeſcribable ſwiftneſs, accompanied with a copious eruption of ſmoke, aſhes, and ſand. A few moments before the report, the ſuperficies of the lava is inflated, and covered with large bubbles; ſome of which are ſeveral feet in diameter, which bubbles preſently burſt, and, at the ſame inſtant, the detonation and fiery ſhower take place. After the exploſion, the lava within the crater ſinks, but ſoon again riſes as before,

fore, and new tumours appear, which again burſt, and produce new exploſions. When the lava ſinks, it produces little or no ſound; but when it riſes, and eſpecially when it begins to be inflated with bubbles, it is accompanied with a ſound, ſimilar, in proportion to the difference of magnitude, to that of a liquor boiling vehemently in a caldron.

I remained in this cavity, which ſo conveniently ſheltered me from danger, an hour and a quarter; during which time, beſides the obſervations I have already ſtated, I was enabled to make the following:

Every ejection, however ſmall, was not only accompanied by an exploſion, but was proportionate to it in its intenſity. Hence, as the ſtones which are only thrown to the height of ten or twenty yards above the crater, are not viſible to the eye at a diſtance, ſo, neither, is the detonation by which ſuch ejections are accompanied, ſenſible to the ear.

In the ſmaller and moderate ejections, the ſtones

ſtones fell back into the crater, and, at their colliſion with the fluid lava, produced, as I have already ſaid, a ſound ſimilar to that of water ſtruck by a number of ſtaves; but in the greater ejections, a conſiderable quantity of them always fell without the mouth; though that lying low, and ſurrounded with heights, the greater part of them rolled again into it. Here, however, we muſt except that ſide of the crater which lies immediately over the precipice before deſcribed, ſince there, every ſtone which fell without the crater, bounded down the declivity, and deſcended to the ſea. When I viewed this precipice from the water, it appeared to me to terminate in a point; but here I diſtinctly perceived, that, where it reached the volcano, it was more than ſixty feet in breadth.

The redneſs of the larger ignited ſtones (which were only pieces of ſcoriaceous lava) was viſible in the air, notwithſtanding the light of the ſun. Many of them claſhed againſt each other and were broken, which happened only when they were at a certain height;

height; for, when they were nearer to the volcano, they frequently adhered, on touching each other, in conſequence of the fluidity they retained. The lava of the crater, when it roſe or fell, emitted but little ſmoke; but a great quantity when it exploded. The ſmoke iſſued from its fiſſures, but almoſt immediately diſappeared after the exploſion. It might be compared to the ſmoke produced by the firing of gunpowder, and which appears and diſappears with the flaſh. This ſmoke appeared to me extraneous to the lava; at leaſt, the fragments of the latter neither ſmoke as they fly in the air, nor after they have reached the ground.

In conſequence of the alternate riſing and ſinking of the lava, according as it is inflated or makes its diſcharge, the depth of the crater cannot be conſidered as conſtant. When the lava is at its height, it may be about five-and-twenty or thirty feet deep, and when it has ſubſided, about forty or fifty; the greateſt ri ing of the lava may, therefore, be eſtimated at about twenty feet.

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If we attentively examine the edges of the crater, we can diſcover no ſigns that the lava has ever overflowed the brink, much leſs that it has poured a torrent down the ſteep ſide of the mountain.

Though the ejections of the larger and heavier ſtones have ſhort intermiſſions, thoſe of the leſſer and lighter have ſcarcely any. Did not the eye perceive how theſe ſhowers of ſtones originate, it would be ſuppoſed that they fell from the ſky: the noiſe of the more violent eruptions, reſembling that of thunder, and the darkneſs occaſioned by the mounting cloud of ſmoke, preſent the image of a tempeſt.

Such were the phenomena of the volcano of Stromboli, which I obſerved with the utmoſt convenience from the ſtation I have deſcribed. Though it is impoſſible perfectly to pourtray ſuch aſtoniſhing ſcenes by any drawing, the repreſentation I have given, in Plate III. of a part of Stromboli, may enable

ble the reader to form a more adequate idea of the principal objects.

In this plate, A A A repreſents the vaſt column of ſmoke which, to the eaſt of the mountain, iſſues from a deep and ſpacious cavern, moving directly upward. B B B, the numerous ſtreams of ſmoke ariſing on the oppoſite ſide, above which I am myſelf repreſented, ſtanding in the cavity of the rock which I have deſcribed, and looking down on the ſhowers of fiery matter ejected from the mouth of the crater, which has an opening in front to afford a view of the internal parts of the crater and the fiery ejections. A part of the latter are repreſented as falling at the top of the precipice which joins to the edges of the volcano, down which they bound, and precipitate into the ſea.

To the appearances already deſcribed, which I obſerved by day, I ſhall add others that preſented themſelves by night; the cavity in the rock, which I have before mentioned,

tioned, affording me the convenience to make my obſervations, likewiſe at that time, in perfect ſecurity.

The ſurface of the burning lava, within the crater, never emitted any ſenſible flame, not even when the bubbles upon it burſt with an exploſion; but it ſhone with a glowing vivid light, and reſembled, in its appearance, melted glaſs in a furnace. From this ſurface the light diffuſed itſelf around, and ſhot upwards, but with irregularity, ſometimes riſing and ſometimes falling, according, as it appeared to me, the lava itſelf roſe or ſunk.

This light in the air became more vivid at every ejection of ignited ſtones; and was likewiſe increaſed in intenſity by the quantity of ſparks that accompanied each ejection, which were produced, in part, from the breaking of a number of the ſtones, in their claſhing againſt each other.

Such was the appearance of the volcano

during the night; but while I was obſerving it, in my ſecure receſs, and contemplating the aſtoniſhing ſpectacle, an unexpected phenomenon excited in me much more alarm than pleaſure. The eruptions of the volcano ſuddenly ceaſed, the boiling lava ſank lower than uſual, without again riſing, and loſt its vivid glowing redneſs; while at the ſame time the numerous ſtreams of ſmoke, to the weſt of the volcano, which before roſe in ſilence, began to iſſue with a loud hiſſing ſound, and the apertures from which they exhaled to ſhine with a bright colour of fire. I know nothing to which the ſound produced by the iſſuing of theſe fumes can be more properly compared than the blowing of large bellows into a furnace by which metals are melted; ſuch as I have ſeen at Zalatna in Tranſylvania, and Scheinnitz, and Kremnitz, in Hungary; except that theſe volcanic bellows roared a hundred times louder, and almoſt deafened the ear.

The unexpected change within the crater, and my nearneſs to thoſe fumes, which,

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as they abounded with highly noxious ſulphureous vapours, I feared might have miſchievous effects, alarmed me ſo much, that I was on the point of abandoning a place which appeared ſo dangerous, and ſeeking ſafety in flight; had not the guides encouraged me to ſtay, aſſuring me, from their repeated experience, that my fears were groundleſs. "The burning matter which "boils within the cavern," ſaid one of them, "always contains a great quantity of air. "This air has at preſent left the fire, and "paſſed through ſubterraneous paſſages to "thoſe apertures from which the ſmoke "iſſues, and which we call *reſpiri* (vent-"holes) becauſe there the air from the fire "finds vent. But there is nothing to fear: "the noiſe of theſe vent-holes will ſoon "ceaſe, and the crater boil and throw out "burning matter as before."

My companion gave me this account in ſuch a manner as ſhewed he had himſelf no idea of danger, and the event happened preciſely as he had foretold. In a very ſhort

time the fumes and the volcano returned to their former ſtate. My two guides afterwards aſſured me that this appearance very rarely happened, and when it did was never of long duration. From this diſcourſe, and other converſation which I had with them afterwards, I perceived that theſe two natives of Stromboli were better acquainted than any other perſon with the ſecrets of their volcano, and the explanation they had given me of the phenomenon I had witneſſed, appeared to me extremely judicious.

I think it cannot be doubted that the bubbles which ariſe in the liquid lava, and burſt with an exploſion, are generated by an elaſtic fluid there collected and confined, which being dilated by the ſtrong action of the fire, and incapable eaſily to diſengage itſelf from the tenacious lava, violently burſts it, and ruſhes above the crater, producing at the ſame time a detonation. Hence originate the ſhowers of ejected matter, which are more or leſs copious, and riſe to a greater or leſs height, in proportion to the greater

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or leſs quantity and ſtrength of this fluid; which eſcaping, at every exploſion, from the upper parts of the lava, theſe ſink, and again riſe when they have received a freſh ſupply. Suppoſing, then, the ſource of the fluid confined, from time to time, within the liquid lava, to be inexhauſtible, we ſhall eaſily perceive that the eruptions muſt be inceſſant. If from the extreme tenacity of the lava, its want of ſufficient fluidity, or any other unknown cauſe, it ſhould be unable to burſt it, and open itſelf a paſſage within the crater, it will make its way through the ſubterraneous channels to thoſe apertures from which the fumes aſcend, through which it will iſſue, with conſiderable noiſe, till the obſtacle it met with in the lava be removed. In ſuch a caſe the lava will ſink without again riſing during this interval, and will loſe its fiery redneſs from being no longer urged by the energy of the elaſtic fluid; while, from the contrary reaſon, the apertures from which the fumes iſſue will acquire a glowing redneſs, becauſe the fluid eſcapes through them with violence.

Such were the ideas which floated in my mind, when, the night being conſiderably advanced, I returned home, with my imagination ſtrongly impreſſed with the objects I had ſeen. Theſe ideas I afterwards, in a cooler moment, recalled to a rigorous examination, enquiring, eſpecially, what might be the nature of volcanic gaſes, not only of ſuch as are impriſoned in the liquid lavas of Stromboli, but of thoſe which are inſeparable from other burning volcanos; as likewiſe in what manner they act, to produce the ejections; objects which appear to me to be at once new and highly intereſting. Theſe enquiries produced a number of obſervations and connected experiments, which it will be more proper to preſent the reader in another part of the work than in this place; both becauſe they regard volcanos in general, and becauſe to detail and explain them would lead me too far from my preſent ſubject, which is to ſpeak of the objects I obſerved in this volcanic country. As I have, therefore, given ſome account of the nature and conformation of

Stromboli,

Stromboli, and the moſt remarkable phenomena of its volcano, I ſhall proceed to deſcribe, in the following chapter, the different ſubſtances of which this iſland is compoſed.

CHAP. XI.

STROMBOLI, CONTINUED.

The component ſubſtances of this iſland are ſcoriæ, lavas, tufas, pumices, and ſpecular iron—Three kinds of ſcoriæ—The firſt kind has ſome degree of vitrification—Stromboli produces no true vitrifications or enamels—The name of pumice not ſuitable to this kind of ſcoria—Its ejection, and the figure which it ſometimes takes in the air—Second kind of ſcoria, for which Stromboli is remarkable—Its decompoſition where the acid-ſulphureous vapours prevail—The ſubſtances thrown out of Stromboli more affected on by the fire, than thoſe ejected by other volcanos—The activity of the fires of Stromboli has long remained the ſame—Falſe opinion of ſome, that volcanic glaſſes derive their origin from re-melted lavas—Third kind of ſcoria—All theſe three kinds of ſcoriæ originally porphyry with

with a horn-ſtone baſe—Enumeration of the different lavas of Stromboli—Its tufas and pumices—Specular iron—Dangerous ſituation in which the latter is found—Its cryſtallization, beauty and variety—Flakes of ſulphate of lime (ſelenite or gypſum) incruſt ſome of theſe cryſtallizations, which conſiſt of very thin leaves of iron faſtened on each other—Hardneſs, and, at the ſame time, fragility of this iron—Changes produced in it, when expoſed to the fire of the furnace, and that excited by oxygenous gas (dephlogiſticated air)—Decompoſed lava the matrix of this ſpecular-iron—Cauſe of this decompoſition—Compariſon between this ſpecular iron diſcovered by the author, and that noticed by others in volcanic matters.—This ſpecular iron produced in the dry way—Rareneſs of it in volcanic countries—Sulphureous acids produce no change in the iron of Stromboli—Its antiquity—The iſland of Stromboli formed by rocks of porphyry, melted by ſubterranean conflagrations, and thrown up by the ſea—Different porphyries of countries not volcanic expoſed

to the fire of the furnace, to compare the changes cauſed in them by that with thoſe produced by the volcanic fire—The epoch of the firſt conflagrations of Stromboli anterior to all hiſtory—Few notices left of them by the ancients—Strabo's accounts of Stromboli and Volcano—The eruptions of the latter mountain muſt have been more frequent and ſtronger, in the time of that geographer, than at preſent—Wind, which, according to Diodorus Siculus, blew from theſe two iſlands—Miſtake of Cluverius, that, in his time, the crater of Stromboli was at the ſummit of the mountain—The moſt ancient epoch of the conflagration of Stromboli, known to us from hiſtory, anterior to the Chriſtian era by about 290 years —Enquiries relative to the matters which have ſo long maintained this conflagration.

THE ſubſtances of which this iſland is formed, at leaſt ſo far as I have been able to diſcover, are ſcoriæ, lavas, pumices, and particular iron; as likewiſe the ſand of which I have ſufficiently ſpoken in the preceding chapter.

chapter. Of the ſcoriæ there are three kinds. The firſt is extremely light, of a dark grey colour, and on it the violence of the fire has taken moſt effect. Some ſmall pieces are coated over with a true varniſh of glaſs; the others, in general, conſiſt of ſemi-tranſparent vitreous threads, ſome of which are as fine as the threads of a ſpider's web. We may, therefore, conclude that the matter was in a ſtate of ſemi-vitrification, when its parts were ſeparated by the claſtic fluids, and rendered extremely porous; but that ſome of it, inſtead of ſeparating, lengthened into threads, which hardened on its contact with the air. We perceive, likewiſe, that only a degree more of heat was neceſſary to render the vitrification complete.

Of the various bodies ejected by the volcano of Stromboli, this kind of ſcoria appears to be that on which it has acted with moſt effect. It has not, however, been changed into a true glaſs, if we except ſome pieces of very inconſiderable ſize. The conflagration of Stromboli has never, therefore, arrived

arrived at this degree of violence; as I could not find, throughout the whole iſland, either vitrifications or enamels. The natives themſelves, indeed, ſufficiently ſatisfied me of their non-exiſtence, as thoſe of the neighbouring iſland of Lipari are well known to the inhabitants of all the Eolian iſles, under the common name of *ſcrizzi*.

But may not the ſcoria here deſcribed as in a great degree filamentous, be conſidered as a ſpecies of pumice? I certainly do not perceive in it the diſtinguiſhing characteriſtics; for the fibrous quality, alone, is not ſufficient. I conclude, therefore, that when any ſtone, in conſequence of the action of volcanic fires, paſſes into the ſtate of pumice, certain determinate conditions are required, either in it, or in the degree of heat to which it is expoſed, or, perhaps, in both, which are not yet ſufficiently known to volcanic naturaliſts, notwithſtanding the attention they have beſtowed on the ſubject. Of this, the preſent ſcoria may furniſh an example. The ſtone which was its baſe, by the action

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of fire, had been diſſolved into lava within the crater; and this lava by the action of elaſtic fluids, and, probably, by that, likewiſe, of ſulphur, has become a filamentous ſubſtance, and, as its filaments are vitreous, appears to ſhew an immediate diſpoſition to change into pumice; but it was not formed by nature to become that ſubſtance, as appears from the ſmall pieces which have aſſumed the thin vitreous coating. Were the fires of Stromboli more violent and powerful, the ſtones which are melted and thrown out would paſs from the ſtate of ſcoria to that of perfect glaſs, without firſt acquiring the nature of pumice.

The ſcoriæ of this kind are never thrown by the volcano, in large pieces, to any great diſtance, from the great eaſe with which they break and pulverize.

It is worthy of remark, that not a few pieces of theſe ſcoriæ incline to a cylindrical figure, and that their filaments are parallel to the axis of the cylinder. Both theſe effects,

effects, in my opinion, may be attributed to the projectile impetus received from the elaſtic fluids when forced from the lava in the crater; thoſe pieces not having had time to take a globular form; both from their ſudden cooling and coagulation in the air, and from the ſmallneſs of their ſize.

I ſhall now proceed to ſpeak of the ſecond kind of ſcoria, I mean that for which Stromboli is celebrated, and of which its ejections principally conſiſt. This ſpecies in its external appearance has no eſſential difference from the former; but its ſpecific gravity is nearly three times as great, it is not at all fibrous, and only exhibits the ſlighteſt ſigns of a beginning vitrification. In other reſpects, like the greater part of ſcoriæ, it is not only rough, ſcattered over with tumours, and irregular figures, and every where ſcorified; but it is full of vacuities of round, oblong, and other forms. The largeſt of theſe are about half an inch in length, and the ſmalleſt almoſt inviſible. They extend through every part of the ſcoria quite to the inner-

innermoſt ſubſtance, even in the largeſt pieces; and in the centre of ſome they are found more numerous and large. Hence it appears that a univerſal effervescence of the elaſtic fluids muſt have prevailed in the ſubſtance of theſe ſcoriæ, while they were in a fluid ſtate. The internal ſurface of each of theſe cavities is, as it were, coated with a dull dark-red varniſh, while the reſt of the ſcoria is black. To diſcover the viſible characteriſtics of this ſcoria, it muſt be examined with a lens in the recent fractures. We then perceive that the grain is not very fine, without brilliancy, and of a uniform texture. Its hardneſs is moderate, its fracture irregular, it gives ſome ſparks with ſteel, emits a weak earthy odour, and attracts the magnetic needle at the diſtance of half a line. Theſe exterior marks afford ground to believe that this ſcoria has for its baſe the horn-ſtone; and its component principles confirm the ſuppoſition beyond contradiction.

This baſe, however, is not homogeneous,

ſince

ſince it contains feltſpars and ſhoerls. On examining it with attention, we perceive that it is interſperſed with a great number of ſmall white ſpots, which form a remarkable contraſt with the black ground on which they appear. By having recourſe to the aid of the lens, we diſcover that theſe ſpots are ſcales of feltſpar. As they are quite flat, wherever they are viewed in the fracture, they appear about the thickneſs of a line, but longer when ſeen on a flat ſurface.

The number of the ſhoerls contained in this ſcoria is very conſiderably leſs than that of the feltſpars; but they are much larger. They are of a black colour, and in figure priſms, the length of many of which is five lines, and the breadth two. It is, however, very difficult to extract entire priſms from the ſcoria, on account of the tenacity with which they adhere to it.

They may be obtained much more eaſily in certain low bottoms near the crater, where they may be found ſeparated from the ſco-

ria, the ſmall fragments of which are there accumulated in great quantities. Detached ſhoerls may there be found little altered by the atmoſphere and elements; many of them, indeed, fractured and mutilated, but ſome few entire, and ſtill preſerving their priſmatic figure, which is octohedrous, and terminated by two pyramids*. They will ſcarcely cut glaſs, and conſequently cannot be very hard. Their appearance is vitreous, and they ſeem as uninjured as when they were in the rock, their primitive matrix.

Beſides the feltſpars and ſhoerls, theſe ſcoriæ contain various other ſmall ſtones, which I, at firſt, doubted whether I ſhould conſider as another ſpecies of ſhoerls, or as what have been called volcanic chryſolites. They have the tranſparency of glaſs, and are of

* The original has "two dihedrous pyramids," (*due piramidi diedre*) But (as the German Tranſlator has rightly remarked) who has ever ſeen a pyramid with only two ſides? I have, therefore, with him, omitted the word, which muſt have been inſerted by ſome miſtake. T.

beautiful colours. Some are of a fine grafs green, others of a deeper emerald green, and others of a mixture of green and yellow. Some of thefe qualities, which are common to chryfolites, and to certain fpecies of fhoerls, caufed me to doubt, when I firft examined them, whether I fhould clafs them with the former or the latter. But befides that I could not difcover that they had any regular figure, the eafe with which they were fufed with the blow-pipe, determined me rather to confider them as fhoerls.

From the obfervations that have already been made, it feems clear that thefe two fpecies of fcoriæ are of the nature of porphyry; as they are compofed of a horn-ftone in which feltfpars and fhoerls are incorporated.*

* It appears to be proved by the moft recent difcoveries of chemical analyfis, that the bafe of the greater part of porphyries is fhoerl in the mafs, or horn-ftone, or trapp; though it cannot be denied that this bafe is likewife frequently filiceous. Many of the Javas, therefore, of the Phlegrean Fields, which I have defcribed in the firft volume, may be referred to this kind of ftone.

But

But before I diſmiſs this ſecond kind of ſcoria, I muſt make one more obſervation on it. Some pieces of this ſcoria lay near the apertures, from which the ſtreams of ſmoke I have already mentioned, aroſe, to the weſt of the volcano. I collected ſome of theſe, which had almoſt ſtopped up one of the orifices through which the fumes iſſued; and which, conſequently, was ſtrongly acted on by them. Theſe pieces had undergone changes ſimilar to thoſe of the lavas of Solfatara. They had loſt their black colour, were covered with light-yellowiſh cruſt, and were become ſo ſoft that they might be cut with a knife. The ſhoerls, however, in the part where this alteration had taken place, had undergone no change. But the ſulphureous acid which had acted on this ſcoria, beſides having in part decompoſed it, had likewiſe produced in its cavities, ſmall aggregates of ſulphate of alumine (alum), and ſulphate of lime (gypſum). This obſervation I have had an opportunity of making, not on volcanic products long ſince decompoſed, which decompoſition

there is every reaſon to believe muſt have been effected by the means of ſulphureous acids; but, inſtructed by nature herſelf, on a product actually undergoing decompoſition, and thus preſenting an inconteſtable proof of the power of theſe acids to decompoſe ſuch ſubſtances.

I have denominated the principal matters ejected by Stromboli, and on which I have hitherto treated, ſcoriæ; though, according to the judicious and juſt remark of M. Dolomieu, theſe differ from lavas only in having undergone greater alteration within the volcano, having been more inflated, and acquired a ſurface more rugged, and of a more irregular form; and ſuch preciſely is the appearance of the ſtones thrown out by Stromboli. I am aware, however, that the difference of theſe circumſtances is not intrinſic and eſſential; and that, therefore, what I have termed ſcoria may be likewiſe called lava, only more changed in the volcano, ſince it is in ſubſtance the ſame matter melted by the fire, and differently modified

dified by the elaſtic gaſes. I think, notwithſtanding, that I have expreſſed myſelf with ſufficient propriety, when, in the laſt chapter, I ſaid that the lava ſwelled, ſunk, burſt, and was thrown up into the air, though I have afterwards called the congealed pieces of it ſcoriæ, ſince they poſſeſs the characteriſtics of that ſubſtance.

With reſpect to the matters that ferment and boil up in the crater of Stromboli, I ſhall here make a remark which may deſerve conſideration. This volcano, beſides the ſingularity of having been in a continual ſtate of eruption from time immemorial, has alſo this other, that the ſubſtances it ejects are more repeatedly acted on by the fires of its crater than in other volcanos. The latter being ſituated at the ſummit of ſteep mountains, having once thrown out their ignited ſtones beyond the edges of the fiery gulf, never receive them again, as they pour headlong down their ſides. But the crater of Stromboli is ſituated half-way up the mountain, and ſur-

rounded, except only on the ſide which faces the north, by ſteep precipices; ſo that, beſides the ſcoriæ which are thrown up perpendicularly, and fall again immediately into it, great quantities which are thrown beyond its edges roll down the declivities, and return again into it. When we conſider, therefore, for how many ages this recurrence of burning matters into the volcano has continued, we might expect, that from the continued action of the fire they muſt approach very near to a vitreous nature, or rather be changed into perfect glaſs. Yet this is by no means the fact. I cauſed a quantity of ſcoria to be dug up from the depth of eight feet, at no great diſtance from the mouth of the crater, and found it exactly reſemble that on the ſurface, though it muſt have been ejected ſo long a time before. It is likewiſe to be remarked that the ſhoels in the recent ſcoriæ are as entire, and as completely cryſtallized, as thoſe in the moſt ancient.

Theſe obſervations are a certain, and, in my

my opinion, elegant proof, that the activity of the fire has never been, in former ages, either greater or leſs than it is at preſent. Not leſs, ſince then the fuſion of the matters in the crater would not have taken place, and, conſequently, there would have been no eruptions; nor greater (at leaſt not in any conſiderable degree), otherwiſe the ſcoriæ would have been completely vitrified, and the ſhoerls fuſed, as we find them by our common fires, when intenſe.

Hence, likewiſe, appears what little foundation there is for the opinion of ſome naturaliſts, who have ſuppoſed that volcanic glaſſes owe their origin to the refuſion of lavas; ſince, as we have ſeen, no true glaſs has ever been thrown out by Stromboli, notwithſtanding the multiplied refuſions of the ejected ſcoriæ, or ſcoriaceous lavas, if any ſhould chooſe to call them by that name.*

But

* With reſpect to the matters ejected by Stromboli which ſcorify and do not vitrify, it may, perhaps, be ſaid that this does not happen, becauſe they have not

But it is time to conſider the third ſpecies of ſcoria. This properly belongs to the ancient volcano, and is found, on removing the ſand, at a ſmall depth, on the eaſt ſide of the iſland, a little above the foot of the mountain. It is diſpoſed in ſtrata forming one body with the ſubjacent lavas, which, at ſome diſtant period, flowed from the ſummit of Stromboli into the ſea. The inhabitants make great uſe of this ſcoria to build their houſes, as it is very firm, and very light, which lightneſs ariſes from the ſmall quantity of matter it contains in proportion to its bulk, and its great porouſneſs. As the partitions which ſeparate the cells or pores are very thin, it is difficult properly to examine this ſcoria, which bears the marks of the higheſt antiquity. After as attentive an

caloric enough to become glaſs, but from the quality of theſe matters, which, originating from the horn-ſtone, only produce ſcorification, and that from the quantity of iron they contain.

This reaſoning may, at firſt view, appear plauſible, but is ſufficiently refuted by the eaſy vitrification of theſe ſcoriæ in the furnace, as we ſhall ſee preſently.

examination as I could beſtow, I diſcovered in it black ſhoerls, and white feltſpars. The body of its ſubſtance does not differ, that I could perceive, from that of the other two kinds.

Having thus deſcribed the three kinds of ſcoriæ of Stromboli; though I do not mean to ſay that other enquirers may not diſcover more ſpecies, I ſhall next proceed to enumerate and deſcribe the lavas, which, for the ſake of order, I ſhall divide into porous and ſolid, beginning with the former.

I. This lava forms an aſcent of ſome hundred paces, to the weſt of the iſland. The eye does not heſitate a moment to recognize it as a product not at all differing in ſubſtance from the ſecond ſpecies of ſcoria. It has the ſame ground, conſiſtence, and colour; and contains the ſame feltſpars and ſhoerls, both of which are in like manner unmutilated, and have the ſame cryſtallization. It likewiſe gives ſparks, in the ſame manner, with ſteel. But the ſize and num-

ber

ber of its cavities, or pores, is leſs, the ſolid parts are more ſmooth, nor have they in their grain that irregularity which appears to be inſeparable from ſcoriæ. We might therefore ſuppoſe, that it is the produce of the preſent volcano; nor ſhould I object to that ſuppoſition, were the courſe of the lava on that ſide; but I find it is directed towards the ſummit of the mountain, where there is every reaſon to believe the greater volcano anciently was ſituated. I am, therefore, of opinion that this was its ſource.

II. This lava is leſs porous. The grain has ſomewhat of a ſiliceous appearance. It is ſmooth to the touch, and gives ſparks plentifully with ſteel. It contains but few feltſpar ſcales, but innumerable ſhoerls. It lies on the ſouth ſide of the mountain, in large ſingle ſtones.

III. The difference between this lava and that of No. II. is but ſmall, and conſiſts in its greater poroſity, and a feeble argillaceous odour. This lava is found ſcattered

over the iſland. The petroſilex is the baſe of both theſe lavas.

I ſhall now ſpeak of the ſolid lavas, which I ſo term, not becauſe they are without pores, but becauſe their pores are ſo minute that they eſcape the eye.

I. This lava, notwithſtanding its ſolidity, is friable, and gives ſparks, feebly, with ſteel. It abounds in feltſpars, and ſtill more in ſhoerls. It is of a dark-grey colour; its baſe is horn-ſtone, and, conſequently, it emits an earthy odour.

II. This ſecond ſpecies of ſolid lava is ſtill more friable than the former, and it has a conſiderable argillaceous odour. It contains no ſhoerls, but ſo abounds in feltſpars that they occupy more than one third of its maſs, and are eaſily diſtinguiſhed, as they are of a ſhining whiteneſs on a brown ground. Their lamellæ are diſtributed equally through its whole contexture. I collected both this lava, and that of No. I. from

from ſeveral currents of it on the ſouth-eaſt ſide of Stromboli.

III. I am in doubt whether I ought to call this ſtone a lava, as it is a porphyry of a beautiful dark-red colour, which changes to a black as ſoon as it is expoſed to the activity of the furnace. The place, likewiſe, in which I found it, contributes to increaſe my doubts. This was a hill of tufa forming a large inclined ſtratum, on the ſouth-eaſt ſide of the iſland, within which it is found in large maſſes. I was led, therefore, to conjecture, that both this porphyry and the tufa might have been thrown out by the volcano without having been expoſed to the violence of the fire. I am ſtill, however, unable to form any determinate concluſion, ſince I am in poſſeſſion of ſeveral other ſpecimens of porphyry, which bear indubitable marks of having been fuſed, though they ſtill retain a beautiful red colour, as will be ſeen when I come to treat of the iſland of Lipari. However this may be, this ſtone has for its baſe the petroſilex, is ſpotted with

with white feltſpars, and takes a fine and brilliant poliſh.

IV. This lava, which is found in a long-continued current, on the ſouth-weſt ſide of Stromboli, contains, as uſual, ſcattered feltſpars. It is of a black colour, of the horn-ſtone baſe, and emits a ſtrong earthy odour. It is accompanied with various greeniſh and black ſhoerls. A number of curling veins and waves appear in it, which, probably, were produced when it flowed from the mountain. Though it is ſolid, it has in it ſeveral ſmall cavities, all of which are long ellipſes, all placed in the direction of the current from which they certainly derive their figure.

Theſe are the ſcoriæ and lavas found at Stromboli, omitting a few varieties, which would only ſwell the work, without adding to its utility.

According to the diviſion I have made, after the lavas, I ſhould proceed to ſpeak of the

the tufas, as I have already given the reader to underſtand they are not wanting in ſome parts of the iſland. But I think I fully deſcribe theſe, when I ſay that they are an argillaceous earth, pulverizable, extremely bibacious, of a grey colour, containing fragments of feltſpar and ſhoerl, and which, in the furnace, hardens without melting. Such, at leaſt, are the characters of the tufas which I obſerved at Stromboli.

I now proceed to the fourth kind of the volcanic productions of this iſland, the pumices. Theſe are found on the eaſt ſide of the mountain, at about one third of its height, on the ſides of ſome path-ways which croſs ſeveral vineyards, and in the furrows made by the deſcent of the waters. They are not found in maſſes, and ſtill leſs in currents, but in ſmall pieces, which are not numerous, and it is eaſy to perceive that they have been brought above ground by the labours of men, or by the action of the rains; and following the traces they afford, we find them buried under the ſand, at the depth

depth of ſeveral feet. Here they are but thinly ſcattered; and are in the ſame ſtate as when thrown out of the volcano. I cannot pretend to aſcertain from what crater they originated, whether the ancient, the preſent, or ſome other, the remembrance and traces of which are loſt; as nothing affords any light to direct my reſearches relative to this obſcure queſtion. I found them in no other part of the iſland. As they do not differ from the more common and known ſpecies, it would be ſuperfluous to give a long deſcription of them. I ſhall only ſay that their baſe is petroſiliceous, with a mixture, as uſual, of feltſpars.

Stromboli has, therefore, at ſome other period, thrown out pumices, though it does not eject them at preſent. A ſimilar change, though on a larger ſcale, we find likewiſe take place in Veſuvius.

The different kinds of ſcoriæ and lavas being expoſed to the fire of the furnace in ſeparate crucibles, the baſe, whether of petro-

ſilex

ſilex or horn-ſtone, changes into a ſhining, ebullient, but hard glaſs, with a fuſion of the ſhoerls, but not of the feltſpars. From the pumice was obtained a glaſs, lighter from the multitude of its pores, of a grey colour, and dully tranſparent.

It now remains to ſpeak of the iron, the fifth and laſt of the volcanic productions which I found on this iſland. This is ſpecular. I am not ignorant that this ſpecies of metal has been likewiſe obſerved in other volcanos; but it gave me pleaſure that I was the firſt who had diſcovered it in the Lipari iſlands; and this pleaſure was conſiderably increaſed, when I perceived that the cryſtallizations of this iron were much larger than thoſe which had been obſerved by others; and, conſequently, much better adapted to ſhew and explain their formation. It is found on the ſouthern ſide of the iſland, at the diſtance of ſomewhat more than a mile from the inhabited part, in a rock of lava, which deſcends almoſt perpendicularly into the ſea, from the height of

about

about a hundred and fifty paces. Some natives of Stromboli having ſhewn me a ſmall ſpecimen of this iron, without knowing what it was, as one of the rarities of their country, I was very deſirous to obtain ſome others, but ſuch as might ſhew the iron ſtill adhering to the matrix, as theſe were detached pieces, found on the beach, under the rock. But to procure new pieces of this production, neither entreaties nor any common offers of reward availed; and, to ſay the truth, ſo great was the labour and danger of obtaining them, that they never could be ſufficiently paid for. To get at theſe ſtones, as they call them, it was neceſſary to go by a very dangerous way, ſcarcely paſſable by the wild goat, much leſs by men, and therefore called, very properly, *il malo paſſo*, the bad or dangerous road. But, to reach the precipice whence the iron is found, ſtill greater danger muſt be encountered, as the rock, beſides its extreme ſteepneſs, is partly fallen down, and the reſt on the point of falling; and it is very difficult to find firm footing on it, without ſlipping, and falling

headlong into the ſea. The deſire of gain, however, added to the habit in which theſe peaſants are of paſſing cliffs and fearful precipices, induced two of them to undertake this enterpriſe, which they ſucceſsfully executed, bringing back with them ſome very beautiful pieces of this iron which they had ſeparated from the lava with a pick-axe. From them I learned that the rock has clefts in many places, and that within thoſe clefts the iron is found.

This metal is cryſtallized in laminæ, vertical to the mother rock, in which they are ſo firmly infixed, that they muſt be broken to obtain them detached. The two faces of every lamina or plate are parallel to each other, or nearly ſo. In general, the plates, at a firſt view, appear oval; but when examined with more attention, they are found to be polygons. The figure of theſe polygons is extremely diverſified. Sometimes they are triangles, terminating, in the upper part, in an obtuſe angle; and ſometimes in a right, or acute angle, though this but rarely.

rarely. Some of thoſe plates have ſix, ſeven, eight, and ſometimes more, ſides; nor is there leſs variety in the length of the ſides, or the meaſure of the contained angles. The ſides are frequently cut by plates, which are triangular, quadrangular, rhomboidal, or of other polygonal figures. Nature, therefore, in the formation of this metal, appears not to have preſcribed to herſelf any ſingle form of cryſtallization; or, at leaſt, if ſhe has, it is not eaſy to diſcover the ſimple primitive figure from which has ariſen ſo great a variety.

The plates or faces have ſuch a brilliancy and poliſh, that if the fineſt ſteel be not inferiour, it certainly is not ſuperiour to them in beauty. They reflect the light equally with the moſt perfect mirrors. The largeſt exceed four inches in length, and three and a half in breadth; but there are innumerable others which are ſmaller; and only one inch, or the half, the third, or the quarter, of an inch, until they become ſo minute as to be only viſible by the microſcope; but they are always cryſtallized in one of the figures already

mentioned. A ſingle lamina is never ſeen, but they are always in groups, which groups are ſometimes twenty or more inches in circuit. The number of them, therefore, is very great.

I muſt not here omit to mention a peculiar circumſtance, which uſually attends theſe cryſtallizations. The circumference of theſe thick metallic groups is formed of laminæ ſo minute, that a ſtrong lens is neceſſary to diſcern them; but they become gradually larger as they approach the centre, where they are largeſt of all. There are alſo places in theſe groups where Nature ſeems rather to have ſketched than completed her work. We find there groups or ſmall maſſes of iron which preſent only the firſt principle of cryſtallization. In others we do not find even this ſketch, but only a cruſt attached to the matrix. There are alſo places in which a number of ſmall tumours ariſe, that viewed with the naked eye appear to be without form, but when examined with the lens, are diſcovered to con-

conſiſt of a multitude of ſmall laminæ irregularly conglutinated. In the ſame manner, ſome cruſts are formed, in ſome places three lines in thickneſs, which, both internally and on the ſuperficies, are found to be compoſed of an aggregate of laminæ thrown irregularly on each other.

In reference to ſome obſervations I ſhall hereafter have to make, I muſt mention that ſome of theſe aggregates of laminæ are either entirely covered with a coating of ſulphate of lime, ſo that it muſt be taken off to get at them, or at leaſt only the upper part of them riſes above it. This coating is of a very white colour, and ſo ſtrongly attached to the iron, that it appears like wax that has been poured over it and hardened.

The colour of theſe laminæ, in general, greatly reſembles that of the fineſt and moſt brilliant ſteel; except ſome which have a violet tincture. They are as reſplendent in the fractures as on the faces. Notwithſtand-

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ing their great hardneſs, they are nearly as brittle as glaſs.

On carefully examining theſe laminæ, a phenomenon preſented itſelf which increaſed my attention. This was ſome ſcales parallel to each other, which arole from the faces of theſe cryſtals, and induced me to ſuſpect that their compoſition might be the reſult of a number of ſmall leaves united and conglutinated together. An inſpection of the larger laminæ convinced me that this conjecture was well founded; for, on breaking them croſſwiſe, I frequently found in the fractures very ſmall leaves. There are alſo ſome which very evidently ſhew them, and in great numbers on their faces. A leaf, for example, may occupy a ſixth part of the face, and there end. Further on under that another appears, which extends another ſixth, and then terminates like the former. Still farther, under the ſecond leaf, appears a third, which extends only a ſmall ſpace; and in like manner others: ſo that the lamina will be the leſs, the ſmaller the number

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of the leaves of which it is compoſed. I ſhall here avail myſelf of a compariſon, which, though not very ſcientific, will aptly explain what I mean. When a number of leaves of paper are, firſt, rolled up, and afterwards ſpread out on a flat ſurface, it will happen, on their unrolling, that each will ſeparate a little from the next, ſo that they may all be numbered; and it will be evident that the firſt, which is above all the reſt, renders the heap larger, and that the leaves being ſucceſſively taken away, the heap will be diminiſhed, until it will at length only conſiſt of the ſingle laſt leaf.

The laminæ, however, are not all compoſed in this manner. In ſome, the component ſcales are conglutinated in ſuch a manner that they do not appear, and the texture preſents a continued ſurface. Yet there are but few laminæ ſo ſmooth on both their faces as not to ſhew the preſence of ſome leaf. More than once I have found on one lamina others attached which ſhewed they were of later formation.

Theſe facts, when compared, muſt remove every doubt with reſpect to the nature of the formation of theſe noble cryſtals, as it is manifeſt they are compoſed of a greater or leſs number of ſmall plates, which, placed upon, and adhering to, each other, form the larger laminæ.

Among all the volcanic productions which I met with and collected in my travels, there is not one which gives ſparks ſo plentifully with ſteel, or influences the magnetic needle at ſo great a diſtance, as this of which I now treat.

Almoſt every lamina, part, or fragment of this production poſſeſſes polarity, attracting the magnetic needle at one end, and repelling it at the other; which attraction and repulſion are equal in force. The ſame powers of attracting and repelling are equally found in the cruſts of iron apparently not cryſtallized, and in their parts.

Notwithſtanding, however, its power to move

move the magnetic needle, it is ſcarcely at all acted on by the magnet, at leaſt, not unleſs it be reduced to very ſmall particles.

When approached to the Leyden phial, it freely conducts the electric ſhock.

The furnace has no other effect on it than to deprive the laminæ of their brilliancy, and diminiſh, in a ſmall degree, its magnetic virtue, which is not deſtroyed even by the fuſion of the laminæ; to obtain which the blowing pipe is not ſufficient; but oxygenous gas (dephlogiſticated air) muſt be applied for about two minutes, as one will not be long enough. The little ball into which a ſmall lamina of ſpecular iron is converted, loſes on its ſurface all brilliancy, and acquires the colour of lead expoſed to the air. Internally, however, it ſtill retains ſome reſplendence; but the friability of its parts is increaſed, and it gives but few ſparks with ſteel. The ſame change takes place in this metal which is ſo frequently obſervable in other bodies after having been in a ſtate of fuſion:

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it is interſperſed with ſmall air-bubbles, and rendered, in a manner, ſpongy.

Such are the principal properties of the ſpecular iron which I diſcovered at Stromboli. But it is of importance to know, of what nature is its matrix. This is a lava which does not eſſentially differ from thoſe lavas of this volcanic country which are of the horn-ſtone baſe, except that it has undergone great changes. It is ſo friable, that it may be ſcratched with the nail. Inſtead of being black, or dark brown, it is of a cinereous, and, in ſome places, of a reddiſh colour. It is extremely porous, and, therefore, light; and its grain rough and dry, not unlike that of ſome ſand-ſtones. Its odour is argillaceous, and it adheres ſtrongly to the tongue, like a burnt bone. When immerſed in water, it imbibes it with a hiſſing noiſe, and ſaturates itſelf with it.

Beſides that it gives no ſparks whatever with ſteel, this lava has not the ſmalleſt effect on the magnetic needle, except when

ſome ſmall particle of ſpecular iron ſtill remains within it; for though the latter principally covers the external ſurface of the lava, a number of microſcopic laminæ glitter, here and there, in its internal pores.

The ſmall feltſpar cryſtals in this changed lava are entire, but their natural brilliancy is diminiſhed, and they are cracked. It is neceſſary to look with attention to diſtinguiſh them from the ſubſtance of the lava, as their colour is the ſame; but they are much more eaſily diſcernible when the lava has been expoſed to the furnace, ſince they have then acquired a greater degree of whiteneſs, and are ſeen through a thin blackiſh cruſt of enamel, into which the ſurface of the lava is changed. This, however, in a few ſeconds, is entirely freed from the oxygenous gas, and a homogeneous but ebullient enamel is produced.

The great analogy between the alteration undergone by this lava and the changes pro-

produced in many others by the action of ſulphureous acids, ſufficiently ſhews that it proceeds from the ſame cauſe. This is likewiſe evidently confirmed, by the thin cruſts of ſulphate of lime with which it is coated, and which have been generated by the ſulphureous acids, combined with the ſmall portion of lime contained within the horn-ſtone.

It will here not be improper to give a conciſe account of ſome obſervations of a ſimilar kind with thoſe I have made, that, by comparing both, we may be enabled to deduce ſuch concluſions as may elucidate the ſubject.

The firſt author, who, to my knowledge, has ſpoken of cryſtallized iron adhering to volcanic matters, is M. Faujas in his *Mineralogie des Volcans*. He tells us that he found in Velvic, in Auvergne *, a homogeneous and heavy lava, from the ſurface and fiſſures

* Now the department of Velay. T

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of which projected a great number of ſmall thin plates of iron, which had the luſtre of the fineſt poliſhed ſteel. Though he does not give their ſize, there is reaſon to believe they muſt have been almoſt microſcopic; ſince he ſays a lens of conſiderable magnifying power was neceſſary to diſcover that ſome of theſe plates were ſegments of hexagonal priſms, and that others conſiſted of two hexagonal pyramids joined at the baſe. They were attracted by the magnet. The lava to which they adhered, according to him, was baſaltic, but greatly altered, having become white, cracked, friable and ſoftened.

M. De Larbre, phyſician at Riom, examined with great care, both the iron of Volvic above mentioned, and that of the Puy de Dome and Mont d'Or in the ſame province*. The cryſtals of the latter iron are ſections of octahedrons ſimilar to thoſe of alum, and

* See his diſſertation in the *Journal de Phyſique* par l'Abbé Rozier, l'an 1786.

ſometimes

ſometimes perfect octahedrons. It is at Mont d'Or that the cryſtallizations, or plates, of ſpecular iron are moſt beautiful and diſtinct. The largeſt are about an inch and a half in breadth, ſomewhat more in length, and about a line and a half, or, at moſt, two lines, in thickneſs. The faces of the plates, when viewed with the lens, diſcover ſtreaks and diminutions which prove the accumulation of a number of ſmall laminæ.

The ſpecular iron of the three abovementioned places in Auvergne poſſeſſes a magnetic quality, and many pieces of it attract the magnetic needle on one ſide, and repel it on the other.

M. De Larbre remarks, that the ſpecular cryſtallized irons of Mont d'Or, the Puy de Dome, and Volvic, have the ſame matrix, that is, a cellular and pumiceous lava; and that this lava has been more or leſs changed by the action of acids.

Laſtly, a third ſpecimen of the cryſtals of ſpecu-

ſpecular iron has been deſcribed by the commendator Dolomieu, which was found by him on ſome ſolid lavas, at Jaci Reale, and on different ſcoriæ, which had been changed and ſoftened by acid ſulphureous vapours, in the crater of Monte Roſſo. Thoſe found at the former place were thin ſhining plates, of a regular hexagonal figure, hard, ſlightly attracted by the magnet, and the largeſt not exceeding a line and a half. Thoſe of Monte Roſſo conſiſted only of ſmall, thin, irregular ſcales.

When I compare theſe obſervations on ſpecular iron with my own, I find that they greatly reſemble them. The iron deſcribed by theſe authors is, like mine, cryſtallized; but the cryſtallization is different, and the laminæ of the iron of Stromboli are larger than thoſe of that of Auvergne and Etna. The beautiful luſtre, like that of ſteel, and the magnetic virtue, are the ſame in both. The formation of the cryſtals of Auvergne is obſerved to ariſe from the appoſition of ſmall ſcales, as I obſerved in mine, only that,

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in the latter, it is more diſtinctly ſeen. Laſtly, the lavas in which this ſpecular iron is found, excepting thoſe of Jaci Reale, have all undergone a change.

This identity in the effects naturally induces to conclude an identity of cauſe. The three naturaliſts above cited are of opinion, that the formation of theſe martial cryſtals is to be aſcribed to the volcanic fire; by the action of which the metal was ſeparated from the lava of which it made a part, and ſublimed; and that, afterwards, falling on the ſurface, and into the cleſts, it there attached and collected, taking a regular form. This explanation is, certainly, not only the moſt natural, but is confirmed by facts; ſince iron, in crucibles, uſing certain precautions, cryſtallizes in a ſimilar manner, as has been obſerved by MM. Grignon, Faujas, and Buffon. I am therefore of the ſame opinion relative to the ſpecular iron of Stromboli, that is, that the vehement heat of the fire deprived the lavas of this metal, by ſubliming it, which afterwards attached to their

ſurface, producing laminated cryſtals, more or leſs large, and more or leſs numerous, with thoſe varieties which uſually accompany cryſtallizations. In fact, while almoſt all the other lavas of Stromboli move the magnetic needle, thoſe which have cryſtallizations of iron on their ſurface, have not the leaſt effect on it; no doubt becauſe they are in a great meaſure deprived of that metal. But as, in general, the fire has acted on the other lavas, in the ſame manner as on thoſe which exhibit the ſpecular iron, and as, beſides, the ſpecimens of the latter are not numerous in volcanized countries (ſince, excepting the places above mentioned, and ſome of the Phlegrean-fields*, I know none where this cryſtallized iron is found), it ſeems not to be doubted but ſome other circumſtance, beſides the fire, muſt concur to its formation; which perhaps may be the union of the iron with the muriate of ammoniac, as it is well known that by ſuch a union that metal is ſublimed and paſſes into the nature of ſpecular iron.

See Chap. V.

We have ſeen that the ſpecular iron of Stromboli is, in many places, covered with ſulphate of lime; and ſince this ſulphate derives its formation from the action of the ſulphureous acids, they muſt have acted likewiſe on the metal, the cryſtallization of which is anterior in its origin to this neutral ſalt, which cloſely inveſts and covers it. But though theſe acids are ſufficiently powerful to attack and decompoſe the moſt ſolid and hard lavas, they have not been able to make any impreſſion on the ſpecular cryſtals, which have likewiſe reſiſted all the ſhocks of other deſtructive cauſes, among which the aëriform fluids floating in the atmoſphere are no ſmall part, and ſtill retain that brilliant luſtre which they received at firſt, notwithſtanding the antiquity of their production, which is probably the ſame with that of Stromboli itſelf, of which the annals of time afford no memory. For, in fact, theſe cryſtallizations being found adhering to a rock formed of ſtrata of lava, which ſerves as a foundation to almoſt the whole ſuperſtructure of the mountain, we cannot recur

to any times known to hiſtory, but muſt go back to that moſt remote period in which the iſland was formed by ſubterraneous conflagrations.

We have now finiſhed the deſcription of the volcanic products of Stromboli; I mean the ſand, ſcoriæ, lavas, tufas, pumices, and ſpecular iron. Omitting this metal, the pumices, and the tufa, three productions which occupy only a ſmall corner of Stromboli, this iſland may be ſaid to be formed, as far at leaſt as externally appears, of ſcoriæ and lavas; and ſince theſe ſcoriæ and lavas have been ſhewn to derive their origin from porphyry rocks, partly with the horn-ſtone baſe, and partly with that of the petroſilex, it muſt be concluded, that the material origin and increaſe of Stromboli is to be attributed to porphyry, which, melted by ſubterranean conflagrations, and rarified by elaſtic gaſeous ſubſtances, aroſe from the bottom of the ſea, and, extending itſelf on the ſides, in lavas and ſcoriæ, has formed an iſland of its

preſent ſize. Theſe porphyry rocks likewiſe ſtill furniſh matter for the preſent eruptions.

Before I conclude this chapter, I muſt not omit two enquiries which I conſider as of no little importance. In my reſearches relative to volcanos, I have propoſed as a rule, to ſubject the volcanized bodies to the action of the furnace, in order to compare the activity and manner of action of the ſubterranean fires with that of our common fire; and I have found this practice, and expect ſtill to find it, not a little inſtructive. But with reſpect to the Eolian iſles, which I have ſtudied with the greateſt attention, I have judged it proper to make other experiments of the following kind.

Having aſcertained, by various obſervations, the different kinds of primitive rocks, which by their fuſion have contributed to the formation of each of theſe iſlands; I reſolved to ſubject to the furnace rocks of a ſimilar nature, but brought from countries

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not volcanic, remarking in what manner they were affected by our common fire, and thus make a compariſon of another kind, which muſt be of equal utility with the former.

To this enquiry, which has perhaps been firſt made by myſelf, I ſhall add another, relative to the accounts left us by the ancients concerning the conflagrations of Stromboli, which I ſhall ſtate and conſider. I ſhall proceed in the ſame manner with reſpect to the other iſlands, as an examination of theſe accounts will enable us to compare the preſent ſtate of theſe countries produced by ſubterraneous conflagrations with that of former times.

With reſpect to the firſt object of reſearch, as the principal materials of Stromboli derive their origin from rocks of porphyry, I ſhall briefly relate the reſults of experiments made on different kinds of this ſtone, in its natural ſtate, expoſed, in the uſual manner, to the furnace; and I requeſt my courteous

readers to endure the fatigue of reading theſe experiments, ſince I endured the fatigue of making them.

I. This porphyry is Egyptian. Its colour is a dark red, its baſe compact; and its recent fractures fine and earthy. It gives ſparks plentifully with ſteel, and breaks into irregular pieces. The baſe includes a few black, ſhining, linear, and opake, ſhoerls; with abundance of feltſpars of two kinds; the one quadrangular, of a pale red colour, and almoſt opake; the other likewiſe quadrangular, but tranſparent and brilliant. It is well known that this porphyry takes a fine poliſh, which renders it very beautiful to the eye.

After remaining twenty-four hours in the furnace, it is perfectly fuſed; when it is changed into a black enamel, minutely ſpotted with aſh-grey points, which are feltſpars. Theſe, therefore, continue entire. This enamel abounds in pores, gives fire with ſteel, but leſs than the porphyry, has

has a lively luſtre, and is tranſparent in the angles.

If this ſtone remains in the furnace eight-and-forty hours ſucceſſively, it becomes a compact enamel, uniformly black, from the complete fuſion of the feltſpars, which then form with the baſe one homogeneous whole.

It has been the opinion of many celebrated naturaliſts, that the baſe of the Egyptian porphyry is a jaſper; but the eaſy fuſion of it in the glaſs-furnace convinces me of the contrary; and I find one of the moſt eminent of our modern lithologiſts agrees with me in that concluſion. To obtain, however, as much certainty as poſſible, on this point, which I conſidered as important, I expoſed ſome jaſpers to the heat of the ſame furnace, but no fuſion took place. The following are the reſults of my experiments on five different kinds of jaſper, which I expoſed, in ſmall fragments, to the fire of the furnace, during forty-eight hours.

The firſt jaſper was of the yellow colour of honey, interrupted with red ſtreaks, with a grain rather ſiliceous than earthy, and received a beautiful poliſh, though with little luſtre. This became lighter, extremely friable, of a colour approaching that of iron, the red ſtreaks having acquired that of ſealing-wax. No fuſion followed, except in ſome parts, which, being higher than the reſt in the crucible, had been more expoſed to the violence of the fire, and were covered with a very thin vitreous coating.

The ſecond jaſper was of the yellow colour of wax, of a fine grain, and ſiliceous, gave ſparks plentifully with ſteel, and took a very beautiful poliſh. This only underwent a conſiderable degree of calcination, by which it became light, friable, full of cracks, and of a blackiſh-brown.

The ſame colour, and the ſame calcination, without any ſign of fuſion, was obſervable likewiſe in a third jaſper, of a blood-

red

red colour, of an appearance between the ſiliceous and the argillaceous, and leſs hard than the ſecond kind.

A fourth and fifth ſpecies equally reſiſted fuſion. One of theſe was of a dark-red, and the other of a mixed colour. Both were of a grain rather ſiliceous, gave ſparks with ſteel, and, like the other three, were entirely opake.

Theſe five kinds of jaſper were brought, ſome from Lower Hungary, and ſome from Germany; and all the five, as has been ſeen, were infuſible in the glaſs-furnace.

The experiments I have here deſcribed perfectly agree with thoſe of M. D'Arcet, who found the ſame infuſibility in four kinds of jaſper, notwithſtanding they were reduced to powder, and expoſed to the action of the moſt violent fire employed in the manufacture of porcelain. M. Mongez found this ſtone equally infuſible with the blowing-pipe.

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Theſe facts, therefore, convince me that the baſe of the porphyry cannot be a jaſper; for, had it been, it would not have melted. I muſt add, likewiſe, that I obtained the ſame eaſy fuſion from two other kinds of oriental porphyry.

Dolomieu and Delametherie, who both agree that the baſe of the Egyptian porphyry is not jaſper, differ, nevertheleſs, as to what this baſe is, the former maintaining it is petroſilex, and the latter, that it is horn-ſtone. The chemical analyſis, however, adduced by M. Delametherie of a red porphyry, ſimilar to mine, which ſhews its baſe to be horn-ſtone, induces me to prefer his opinion to that of the other French naturaliſt. I have not yet had leiſure to examine chemically the Egyptian porphyries which I expoſed to the action of the fire; but of this operation, which I certainly ſhall not omit, I ſhall give an account hereafter, when, in another part of this work, I ſhall have occaſion to ſay more of volcanic porphyries.

phyries. At preſent, let us return to our ſubject.

II. This porphyry, which has the petroſilex for its baſe, is of a blueiſh red, of a grain moderately fine, angular in its fractures, of middling hardneſs, and heavy. It contains very brilliant quadrangular ſcales of feltſpar, and a few ſmall leaves of black mica.

In the furnace this ſtone produced a compact enamel which gave ſparks plentifully with ſteel, very even in its fractures, tranſparent at the angles, and of a dark cinereous colour, with ſome black ſpots, which were half-fuſed mica. The feltſpars remained entire but calcined. This enamel, on the ſurface where the heat had acted with moſt violence, was inveſted with a very thin vitreous coating, which was ſemi-tranſparent, and of a topaz colour.

III. In this porphyry, the feltſpars, which were in round ſcales, but little brilliant, and of

of a yellowiſh colour, are included in a petroſiliceous ground, of a reddiſh brown, of a ſcaly fracture, and which contains points of ſteatites.

To melt it entirely, it requires a continuance of thirty-ſix hours in the furnace, when a dully tranſparent, hard, compact glaſs is produced, of the colour of the common chalcedony, in which the feltſpars are preſerved entire, though changed to a milky whiteneſs.

IV. The petroſilex, which is the baſe of the preſent porphyry, and which, both in its ſubſtance and grain, approaches very near to the common flint, is ſemi-tranſparent, of an olive green; its feltſpars are quadrangular, and of a changing aſpect.

It is infuſible in the furnace, except on the ſurface, which is changed into a tranſparent and compact glaſs, without the fuſion of its feltſpars.

V. The

V. The feltſpars in this porphyry are very brilliant and ſparkling: they are found in a petroſiliceous ground, of a pale roſe red, ſcaly, opake, and of moderate hardneſs.

In the furnace the feltſpars loſe, by calcination, the beauty of their changing colours, and their compactneſs from the number of cracks they contract: the petroſiliceous baſe is likewiſe tranſmuted into a dully tranſparent glaſs, of the colour of ſoot.

VI. This porphyry is extremely compact, hard, and heavy. Its baſe is a clear red petroſilex, of an equal grain, ſmooth, and containing ſmall quadrangular ſcales of brilliant feltſpars.

A continuance in the furnace of not leſs than forty-eight hours is neceſſary for this porphyry to acquire an imperfect vitrification. It is then tranſparent at the angles, of a black colour, and has loſt its natural hardneſs: the feltſpars it contains, however, ſhew no ſigns of fuſion.

Beſides

Beſides the ſix porphyries already deſcribed, the baſe of which is petroſilex, I made experiments, in the ſame fire, on ſome ſpecimens of pure petroſilex, of which I ſhall not give a particular account, to avoid ſuperfluous prolixity. I ſhall only ſay, in general, that I found them refractory, that they abounded in ſilex, and that they formed, as it were, the point of tranſition of the petroſilex into the ſilex. On the contrary, all the reſt are more or leſs fuſible.

I likewiſe made ſimilar experiments on ſome natural porphyries, with the hornſtone baſe; many of theſe having likewiſe ſuffered the fires of Stromboli.

VII. The baſe of this porphyry is not ſufficiently hard to give ſparks with ſteel. It is of a dark grey, earthy, unequal in its fractures, ſoft to the touch, yielding a ſenſible argillaceous odour, and containing, beſides ſome grains of a cryſtal and pellucid quartz, a great number of white feltſpars, which, being eaſily cut with a penknife, ſhew

ſhew how great a change they have undergone from the influence of the ſeaſons and the atmoſphere.

The furnace changed this porphyry into a black ſcoria of little conſiſtence, and its feltſpars aſſumed a vitreous appearance, though without any ſenſible fuſion.

VIII. This ſtone, at firſt ſight, would rather be taken for a granite than a porphyry, as we find in it quartz, mica, and feltſpar, did we not obſerve that the three latter ſubſtances are united in a common cement or paſte, which is a horn-ſtone, rather ſoft, of a cinereous colour, and an argillaceous odour.

The three ſubſtances remain entire in the furnace; but the ground in which they are included, is changed into a hard, black, and ſhining enamel.

IX. The baſe of this porphyry is a horn-ſtone of rather a fine grain, ſufficiently hard to give ſparks with ſteel, of a greeniſh colour,

our, and emits a ſtrong earthy odour. Some of its feltſpars form rather large irregular maſſes of a brick red colour; and others ſmall quadrangular cryſtals of a light yellow colour.

This ſtone is changed by the furnace into a black enamel, moderately inflated, and hard. Its feltſpars, however, remain entire, only with the change of their red colour into a white.

X. The horn-ſtone of the preſent porphyry is laminated, of a ſmooth ſurface, eaſily cut with the knife, and of a reddiſh-green colour. Its feltſpars are rhomboidal; and ſome are four lines and a half in length and three in thickneſs.

In the furnace they remain unaltered; but the ground of the porphyry is changed into a black and hard ſcoria, full of little bubbles.

I ſhall omit the deſcription of many other porphyries, the baſe of which was in like manner

manner horn-ſtone, and on which I made the ſame experiments, ſince the reſults were eſſentially the ſame with thoſe already ſtated. I ſhall only mention that theſe different ſpecies of porphyry, ſome of which had the petroſilex, and others the horn-ſtone for their baſe, were brought from thoſe parts of Hungary and Germany, where, according to the obſervations of ſcientific travellers, no traces whatever of volcanization are diſcoverable.

If we now compare the effects of the volcanic fires and our common fire on theſe various kinds of porphyries, we ſhall find that the principal difference is, that the furnace vitrifies them, deſtroying their original ſtructure, whereas the fires of Stromboli ſeldom change their natural lineaments. In both caſes we find the feltſpars, for the moſt part, remain infuſible; but what appears of moſt importance to the preſent object of our reſearch is, that the ſtones with a petroſiliceous baſe, as well as thoſe with that of horn-ſtone, may be fuſed in a ſtrong heat (ſuch as

that of the glaſs furnace) and without its being neceſſary to have recourſe to the moſt vehement that can be procured.

From theſe experiments we learn, therefore, in what manner the ſubterranean fire of Stromboli, even though we ſhould not conſider it as extraordinarily active, may have been able to melt, and may ſtill continue to liquefy, the rocks of porphyry which have exiſted, and ſtill exiſt, in the abyſſes of that mountain. The facility, likewiſe, with which its lavas may be re-melted in a glaſs furnace, is a ſtrong confirmation of the hypotheſis.

With reſpect to the time when this volcano began to exert its activity, and to melt theſe rocks, we are profoundly ignorant, this being an epocha anterior to all hiſtory. We muſt be contented with the imperfect accounts the ancients have left us of the conflagrations of Stromboli, which did not burſt forth in their time, but ages before. Of theſe accounts I ſhall proceed to give a conciſe

ciſe view, this being the ſecond enquiry it was propoſed to make, and it will neceſſarily be brief, as the notices left us on this ſubject by the ancients are extremely few.

Euſtatius, Solinus, and Pliny, inform us that the flames of Stromboli are leſs powerful than thoſe of the other iſlands of Lipari, but that they exceed them in clearneſs and ſplendour. Theſe writers, however, were only the copiers of Strabo, or perhaps ſome abridgment of him, in which he is copied incorrectly. We ſhall therefore have recourſe to that celebrated Grecian geographer himſelf; who, after having mentioned Lipari and Vulcano, and informed us that Stromboli likewiſe burns, tells us that the latter iſland compared to the others, is inferior to them in the violent eruption of its flames, but that it exceeds them in their brightneſs*.

* Ἐστὶ δὲ (Στρογγύλη) καὶ αυτὴ διάπυρος, βίᾳ μὲν φλογὸς λειπομένη, τῷ δὲ φέγγει πλεονεκτοῦσα. Lib. VI.

It is evident, that by "the others," Strabo means Vulcano, which was the only one of the Eolian iſles, beſides Stromboli, in a ſtate of conflagration in his time. When I compare Stromboli with Vulcano, I perceive that, even now, there is this difference between the two iſlands, that the flames of the former are much more reſplendent and lively than thoſe of the latter, as will appear when we come to treat of Vulcano; but I cannot ſay that thoſe of Stromboli are leſs violent, as the contrary is certainly the fact. We muſt, however, conclude, that, in thoſe ages, the eruptions of Vulcano were very ſtrong and frequent, which agrees with the teſtimony of Diodorus, and that of Agathocles as cited by the Scholiaſt on Apollonius; the former of whom aſſerts, that, in his time, Vulcano and Stromboli vomited great quantities of ſand and burning ſtones*;

*Ἐν δὲ τῇ Στρογγύλῃ, καὶ τῇ Ἱερᾷ, μέχρι τοῦ νῦν, ἐκ τῶν χασμάτων ἐκπίπτει πνεύματος μέγεθος, καὶ βρόμος ἐξαίσιος. ἐκφυσᾶται δὲ καὶ ἄμμος, καὶ λίθων διαπύρων πλῆθος, καθάπερ ἐπὶ τῶν ὀρῶν καὶ περὶ τὴν Αἴτναν γινόμενον. Lib. V.

and

and the latter, that theſe two iſlands threw out fire, both by day and night *.

There is another circumſtance mentioned by the Sicilian hiſtorian which deſerves notice. This is, that a wind iſſues from both theſe iſlands with a great noiſe. This, in ſome meaſure, agrees with the obſervations I made at Stromboli; and is ſtill more applicable to the other iſland, as will be ſeen when I come to give an account of Vulcano.

Philip Cluverius, in his *Sicilia Antiqua*, ſpeaking of Stromboli, tells us that its crater is ſituated at the ſummit of a mountain, from which it pours forth, both by day and by night, with a horrible noiſe, bright flames, and great quantities of pumice †. In one of the plates prefixed to his work, this iſland is repreſented with

* Αἵτινες (Ἱερά καὶ Στρογγύλη) ἡμέρας καὶ νυκτὸς, πῦρ ἀφιασιν.

† Strongule hodieque liquidiſſimam flammam, et pumices magna copia, ex vertice, ubi craterem habet noctes atque dies, cum fremitu horrendo, eructat.

the ſmoke riſing from the ſummit of the mountain.

Nearly one hundred and ſeventy-three years have now elapſed ſince this author travelled in Sicily. Ought we then to conclude, that, at that time, the mouth of the volcano was ſituated at the ſummit of the mountain? Had the learned antiquary himſelf viſited the iſland, I could not have objected to his evidence. But he not only does not ſay this, but the contrary may be inferred from his own words. Immediately after the paſſage I have already cited, he adds, "ſed perpetui ejus ignes eminus navi- "gantibus, nocte tantum, conſpiciuntur. "Fumum eorum candidiſſimum ex Italiæ "pariter ac Siciliæ littoribus conſpexi." It is therefore evident that he ſaw this volcano only from a diſtance, and that, conſequently, his aſſertion, that the fiery crater was ſituated at the ſummit, is not to be depended on. What he has ſaid of the pumices then thrown out by it, he may have taken on the credit of ſome of the natives

natives who gave him that information, and who confounded the ſcoriaceous lavas with pumices; or it may in fact be true, ſince under the ſcoriæ and lavas of Stromboli, ſcattered pumices are found, as I have obſerved above.

From the authorities above adduced it appears, therefore, that the moſt ancient accounts of the conflagrations of Stromboli, tranſmitted to us by hiſtory, are prior to the Chriſtian era by about 290 years, the date of the reign of Agathocles, the celebrated tyrant of Syracuſe. This volcano burned likewiſe in the times of Auguſtus and Tiberius, when Diodorus and Strabo flouriſhed. But after this latter period, a long ſeries of ages ſucceeds, during which, from want of documents, we are ignorant of the ſtate of Stromboli; and it is not until the ſeventeenth century, that we again know, with certainty, that it ejected fire; though it is not improbable that it continued to burn likewiſe during the times in which we find no mention of it in hiſtory: on which ſup-

poſition, its uninterrupted conflagration, for ſo great a length of time, muſt indeed appear aſtoniſhing. Yet, though it ſhould have ceaſed for ſeveral ages, we know, from various public teſtimonies, that its continued eruptions cannot have laſted leſs than two hundred years.

Here our curioſity may naturally be excited by the queſtion: What are the ſubſtances which, without diminution, have nouriſhed, during ſuch a number of years, and ſtill continue to feed, theſe fires? I do not perceive that there is any reaſon to ſuppoſe them different from thoſe which furniſh fuel to the intermitting volcanos, except that their ſource appears to be inexhauſtible. It is believed, with much reaſon, that ſulphur produces and continues volcanos; and wherever theſe mountains burn, we have indiſputable proofs of its preſence. Still more effectually to explain theſe conflagrations, petroleum has, likewiſe, been called in aid; and, in fact, it has ſometimes been found to iſſue in the neighbourhood

bourhood of a volcano, of which Veſuvius is an example*. The clouds of thick black ſmoke, which frequently riſe into the air from the mouths of volcanos, and the unctuoſity and ſootineſs which are ſaid to be found in the recent ſcoriæ, ſeem likewiſe to be evident indications of ſome bituminous ſublimate.

That Stromboli contains within its deep gulphs and receſſes an immenſe mine of burning ſulphur, we can entertain little doubt, when we conſider the ſtreams of ſmoke, of extraordinary whiteneſs (a colour which conſtantly accompanies ſulphureous fumes), that riſe on the weſt ſide of the iſland, and the ſmell of ſulphur, not only perceptible from them, but from the large cloud of ſmoke which overhangs the ſummit of the mountain. The ſmall pieces of that mineral produced near the apertures whence thoſe fumes ariſe, are likewiſe another proof.

* Serao, Iſtoria dell' Incendio del Veſuvio, del 1737. Borrie, Iſtoria di varj Incendj del Monte Veſuvio.

But of the preſence of petroleum, and its effects, I have never perceived the leaſt ſign. Beſides that no vein of it is found in the iſland, nor any ever ſeen ſwimming on the ſea which ſurrounds Stromboli, as I was aſſured by the general teſtimony of the inhabitants, the ſmell of this bitumen is no where ſenſible, though naturally it is very acute. I have frequently viſited the ſources of petroleum, at Monte Zibio, in the territory of Modena, and I could always perceive the ſmell of their penetrating vapours, at the diſtance of ſeveral hundred paces, before I reached them. I therefore conclude, that theſe vapours muſt have been much more ſenſible at Stromboli, as they would have been much more active, had petroleum actually burned within its gulph. I have, likewiſe, examined, with the greateſt attention, the ſcoriæ thrown out by the volcano, and while they were very hot; but I never could perceive that they emitted, either from their ſurface, or within their pores and cavities, the leaſt ſmell of that bituminous ſubſtance, or that they any

where

where exhibited any unctuous humidity. As I knew that the ſmoke which exhales from burning petroleum is of a blackiſh hue, I ſuſpected that the thick and dark column of ſmoke, which aroſe to the eaſt of the volcano, might be a ſign of its preſence; but, on a nearer approach, I perceived that its darkneſs proceeded from aqueous vapours which were mixed with it, and which, by my continuing a ſhort time in it, rendered my clothes damp and wet.

Shall we then affirm that the fires of Stromboli receive no kind of aliment from this bitumen? Notwithſtanding the obſervations I have ſtated, I would not venture confidently to deduce ſuch a concluſion; ſince it is poſſible that the petroleum may burn under the mountain, at ſo great a depth, that its vapours may not reach to the top, but may be diſperſed and conſumed by the fire, and the immenſe maſs of liquefied matter, which probably extends from the crater to the loweſt roots of the iſland.

But

But though we ſhould not admit the exiſtence of this oil within the deep receſſes of the mountain, I do not perceive but the ſulphur alone may be ſufficient for the nouriſhment of the volcano, when its flame is animated by oxygenous gas, the preſence of which, in volcanic abyſſes, ſeems undeniable, from the ſubſtances they contain proper to generate it, when acted on by the fire. The long duration, without intermiſſion, therefore, of theſe conflagrations, may be very ſufficiently explained by the immenſe quantities of ſulphur, or, to ſpeak more properly, ſulphures of iron which we muſt neceſſarily ſuppoſe contained in the bowels of the mountain; a ſuppoſition rendered the more probable by the prodigious ſubterranean accumulations of this mineral which have been diſcovered in various parts of the globe.

CHAP. XII.

BASILUZZO, BOTTERO, LISCA-BIANCA, DATTOLO, PANARIA, SALINE.

Baſiluzzo, in part, formed of granitous lavas—Its ſterility—Uninhabited—Bottero and Liſca-Bianca, two rocks, in many places decompoſed by acid vapours—Sulphurated hydrogenous gas (hepatic gas) iſſues from the ſea near theſe rocks, which, ſtill, probably, cover the remains of fire—Dattolo formed of lavas in a great meaſure decompoſed—Panaria formed of granitous lavas—This iſland fertile and inhabited—Probability that this group of rocks and ſmall iſlands are the remains of a vaſt ancient volcano—Saline formed by an accumulation of currents of lavas—Courſe of theſe currents to the ſouth of the iſland—Their various ſtratification and nature—Some remains of craters on the ſummit of this iſland—Reſult of experiments

ments in which natural granites were exposed to the furnace, to compare them with those which, by the action of subterranean fires, have contributed to the formation of Basiluzzo and Panaria—An extremely strong fire required for their fusion—A fire equally strong required for the re-fusion of these granitous lavas—Consequence which appears naturally to follow from the great violence of the volcanic fires required to produce the granitous lavas of these two islands.

THOUGH this chapter will contain an account of several islands, it will be very short; since several of them are rather rocks than islands, and they have all been so carefully examined by the Commendator Dolomieu that little remains for me to add to his observations. The first five are situated between Lipari and Stromboli, and it is manifest to ocular inspection that they are the work of fire.

Basiluzzo is about two miles in circumference,

ference, and is raiſed ſome poles above the ſurface of the ſea. On the ſouth ſide is a narrow bay, which I entered on the morning of the 7th of October, on my return from Stromboli to Lipari. I went on ſhore, and, by a winding path, ſoon reached the ſummit, which is a plain of no great extent, and the only place capable of cultivation, though it produces only a little corn and pulſe. This ſcanty vegetation is nouriſhed by a thin cruſt of decompoſed lava, under which we ſoon diſcover the ſolid lava, which, in many ſituations, is granitous, the quartz, feltſpar, and mica, being very apparent in it; as has been before obſerved by the excellent French Naturaliſt above mentioned; and on making the circuit of the iſland we find that almoſt all the remainder of it is compoſed of ſimilar lavas.

Two little cottages which belong to the proprietors of this ungrateful ſoil are the only buildings here. Near them are ſome ancient ruins, amongſt which I found a piece of red porphyry, ſpotted with reddiſh

feltſpars.

feltſpars. I at firſt imagined it a volcanic product, but ſoon changed my opinion; ſince I could not find any ſpecimen of the ſame ſtone on the whole iſland, and becauſe I was convinced, on a more careful examination, that the fragment in queſtion was an ancient Egyptian porphyry, which had been poliſhed by art, and had never been expoſed to the action of the fire. I was therefore induced to believe, from the circumſtances of the place in which I found it, that it had either made a part of the materials of ſome of thoſe ruined edifices, or, which ſeemed more probable, that it had been brought thither by the people who had once inhabited them.

Rabbits are the only animals found in Baſiluzzo; but theſe had nearly reduced to deſpair the few inhabitants of the iſland, by the miſchief they did to their corn, till they at laſt brought againſt them an enemy capable of following them through their ſubterranean holes—I mean the cat.

From

From Baſiluzzo I' proceeded to Bottero and Liſca-Bianca, two rocks abounding in cruſts of ſulphate of alumine (alum), and for the moſt part formed of lavas whitened, and ſo decompoſed that they are eaſily reducible to powder. This decompoſition has manifeſtly been the effect of acid vapours, though of theſe there is, at preſent, no ſign; except that near theſe two rocks we meet with a ſtrong ſmell of ſulphurated hydrogenous gas, and, following it where it is moſt powerful, are led to a ſhallow part of the ſea where a great number of air-bubbles riſe with rapidity, and as ſoon as they reach the ſurface burſt. This gas it is which produces the ſmell.

The ſea could not have been more favourable for the collecting this aëriform fluid; ſince when I ſailed from Lipari to Stromboli it was ſtormy and ran high; but on my return was perfectly calm. I ſecured, therefore, a ſufficient quantity of it in ſome flaſks, which I had taken with me in my journey through the two Sicilies, in order

to make ſome experiments on it when I ſhould arrive at Lipari, the reſult of which I ſhall here, as it ſeems the proper place, lay before the reader.

This gas, when a lighted candle was applied to it, roſe in flame, but with ſcarcely any detonation. It took fire ſlowly, and the flame was of a reddiſh blue. It was therefore a ſulphurated hydrogenous gas, as more evidently appeared from its having depoſited ſome particles of ſulphur in the veſſel in which it was fired. The little depth of the ſea at the place from which this gas iſſued, and its perfect calmneſs, enabled me to make another experiment, by letting down, by means of a ſmall cord, preciſely on the place from which this gas roſe, one of thoſe thermometers, which, in conſequence of being included within ſeveral wrappers, ſlowly receive, and loſe as ſlowly, the temperature to which they may be expoſed. After having left one of theſe immerſed under the water for three quarters of an hour, I found, on drawing it up, that the mercury

had riſen to 28 (96½ of Fahrenheit), though in the atmoſphere above the ſurface it only ſtood at 20½ (69 of Fahrenheit). A hot exhalation therefore aroſe from that part of the bottom together with the ſulphurated hydrogenous gas; an obſervation which renders it probable that a latent fire ſtill remains there. The depth of the water was eleven feet; and it was evident that the bottom was a continuation of the rock Bottero.

Scarcely a mile from Liſca-Bianca and Bottero, towards the weſt, a third rock riſes above the water, named Dattolo, the formation of which is likewiſe to be aſcribed to lavas, in a great degree decompoſed like the former, and ſome of which have an iron-red colour. M. Dolomieu ſays, that a ſpring of boiling water guſhes out at the foot of it; but all my endeavours to diſcover this ſpring were fruitleſs. The ſailors who managed the boat in which I was, and who were natives of Stromboli, and, from making the paſſage from their iſland to Lipari,

ſeveral times in a week, muſt be acquainted with every part of that ſea, and all the rocks it contains, aſſured me that they had never ſeen nor heard of any ſuch ſpring. I ſhall not, however, venture to deny its exiſtence, but am rather willing to believe, that neither they nor I diſcovered it from want of attention. Suppoſing its reality, it certainly is a proof that the conflagration under theſe rocks is not entirely exhauſted.

Proceeding ſtill from Stromboli towards Lipari we next arrive at Panaria, which is not a rock but an iſland, in circuit more than eight miles, though it is but little raiſed above the ſea. The rock of which it is conſtructed is here, likewiſe, volcanic granite; but as it is in many places ſuperficially decompoſed, and in others mixed with ſubſtances very eaſily decompoſable, a rich ſoil is afforded in various parts of the iſland, on which olives, and other fruit-trees, cultivated by many families reſident here, luxuriantly flouriſh.

We

We muſt therefore aſcribe the origin of this group of rocks and iſlands to ſubmarine conflagrations. But are we to conclude that each of them owes its formation to a particular volcano, or that theſe rocks and ſmall iſlands are no other than the remains of a very ancient larger iſland, in a great degree deſtroyed by the powerful action of the waves of the ſea? M. Dolomieu is of the latter opinion, in ſupport of which he adduces many plauſible arguments, conjecturing that this iſland was the ancient *Euonimos*, the ſeventh of the Eolian iſles, which, according to Strabo, lay on the left, in ſailing from Lipari to Sicily, which is exactly the ſituation of the ſmall iſlands I have deſcribed. I ſhall not repeat the reaſons by which he ſupports this conjecture, but refer ſuch of my readers as may be deſirous of examining them to the author's own work.

Late in the night of the ſame day I returned to Lipari, where I had my reſidence, and whence, from time to time, I made ex-

curſions to the other neighbouring iſlands. As the ſea was perfectly calm during the whole of that day, we could make no uſe of our ſails, but were obliged to perform the whole paſſage by the aſſiſtance of our oars. So great a calm in that ſea, which is uſually tempeſtuous, is extremely rare; and, indeed, during my whole continuance among theſe iſlands, I did not witneſs ſuch another day.

In the morning I embarked for Saline, which is ſo near to Lipari, that, by the aid of a light eaſterly wind, I arrived there in leſs than hour. This iſland derives its name of Saline (or the ſalt pits) from the muriate of ſoda (ſea ſalt) which is dug on one part of the ſhore. It was anciently called *Didyme*, or the twin, from its appearing at a diſtance bifurcated, though, on a nearer approach, it is found to be trifurcated, as its ſummit terminates in three points. Among all the Eolian iſlands, this, after Lipari, is the largeſt, ſince it is more than fifteen miles in circuit. From the examination which I made of its ſhores, and the parts of a moderate

derate elevation, I aſcertained that its ſtructure was an accumulation of currents of lavas. Of theſe M. Dolomieu has examined and deſcribed ſeveral: I principally fixed my attention on thoſe which deſcend from the ſouth ſide of the iſland to the ſea. It is evident that they have flowed from the ſummit of the mountain, and fallen almoſt perpendicularly into the ſea, after a courſe of a mile or more. But it is, at the ſame time, equally evident that theſe currents have flowed at different periods. In many places they are found with deep fiſſures, though it is difficult to ſay, whether theſe have ariſen from the lavas ſuddenly congealing, and thence contracting and opening in many places, or whether they have been produced by the action of the rain waters or by ſome other cauſe. However this may be, theſe fractures are a kind of anatomic diſſections of the lava, which ſhew that the upper coat of it lies upon another, and that upon a third, below which are many others. It is alſo to be remarked, that theſe ſtrata are commonly ſpecifically different from each

other. We muſt therefore conclude, that as many currents of lava have flowed from the higheſt part of the mountain, to the ſouth, as there are diſtinct ſtrata; and it is probable, that were we able to penetrate to the moſt internal part of the iſland, we ſhould find the whole, or almoſt the whole of it, of a ſimilar formation.

This certainly is the ſtructure of almoſt all volcanic mountains. Their beginning is but ſmall, and proportionate to the quantity of the firſt eruption; but as the ſucceeding eruptions increaſe in number and extent, they augment in ſize and ſolidity, till in time they acquire conſiderable dimenſions. In this manner, in fact, appears to have been produced the immenſe bulk of Etna, Veſuvius, the iſlands of Lipari, and many other burning mountains. I do not, however, deny that there are ſome which are the offspring of a ſingle eruption, as Monte Nuovo, near Pozzuolo, and Monte Roſſo, on the ſide of Etna.

It appears to me ſuperfluous to particularize the different qualities of the lavas, ſince, as has been obſerved by M. Dolomieu, they are common to other volcanos. I ſhall only remark, in general, that I did not find one which can properly be called ſimple, as they all abound, more or leſs, with feltſpars and ſhoerls, and have for their baſe the petroſilex, and the horn-ſtone.

No traces, at preſent, remain of thoſe volcanic fires which have produced Saline, except the currents of lava, and ſome veſtiges of ancient craters on the ſummits of the mountain.

When treating of Stromboli, we found that the natural rocks, which, by their fuſion, gave birth to the iſland, were a ſpecies of porphyry, having for their baſis either the petroſilex or the horn-ſtone. We have now ſeen that the rocks to which Saline owes its origin are of the ſame kind. But the formation of Baſiluzzo and Panaria has been different; the rocks which have there been con-

converted into lava by the action of the fire being granitous; and it ſeems probable that the ſpacious volcano, which, it has been conjectured, once aroſe in the ſea between Stromboli and Lipari, and of which, at preſent, only ſome ſmall remains exiſt in Baſiluzzo, Dattolo, and Panaria, derived its origin from the ſame ſtone.

In purſuance of the plan I have preſcribed to myſelf of ſubjecting to our common fire ſome natural rocks ſimilar to thoſe from which the Eolian iſles have been formed, I ſhall here deſcribe the effects produced by the furnace on different ſpecimens of granite; and I muſt add, likewiſe, that the difficulty with which, it is well known, granites are fuſed in our common fires, was to me a conſiderable inducement to make theſe experiments.

The furnaces which are worked at Pavia, at a certain ſeaſon of the year, only fuſe common glaſs, that is, ſuch as is blown into ſmall veſſels, and is but little tranſparent, of a yellowiſh

a yellowiſh or greeniſh colour, and uſually full of bubbles; but at another ſeaſon they will melt fine cryſtal glaſs, manufactured for the ſame purpoſes, and which is white, tranſparent, and much purer. The greater part of the volcanic productions mentioned in this work, as alſo the analogous natural ſtones, have melted in the furnace in which common glaſs is made; but the ſpecimens of granite have proved more refractory, and in the ſame degree of heat have only been rendered friable from the enfeebled affinity of their aggregate parts; or, at the utmoſt, a few of them only have been found covered with a thin vitreous varniſh. I was therefore obliged to have recourſe to the furnace in which the cryſtal glaſs is elaborated, when the heat was nearly $87\frac{1}{8}$ degrees of Wedgwood's pyrometer,* or, according to the obſervations of Mr. Wedgwood, only $2\frac{1}{2}$ degrees leſs than the welding heat of iron. The following are the reſults afforded by ſeveral ſpecies of granite, after having been continued in this heat during forty-eight hours.

I. Granite

I. Granite of Mount Baveno, in the Milaneſe. This granite, which forms a great part of the materials of the principal public and private edifices in Milan, Pavia, and other towns in Auſtrian Lombardy, has for its conſtituent principles, quartz, mica, and feltſpar. There are two varieties of it; one in which the feltſpar is white, and the other in which it is of a more or leſs deep fleſh colour.

The fire changed the mica, and produced a beginning fuſion in both the varieties of feltſpar, which abounded with microſcopic bubbles, without however acting as a flux to the quartz, which, calcining, acquired a whiteneſs, without, however, loſing its vitreous nature, and the degree of tranſparency it poſſeſſed. The ſharp angles and projections, if they are feltſpathoſe, become blunted and round; and the fragments, if there are more than one, adhere in conſequence of the ſlight fuſion of the feltſpar, but they never incorporate into one maſs within

within the crucible; on the contrary, they become extremely friable.

II. Mount Baveno likewiſe produces a granite which may be conſidered as a different ſpecies from that now deſcribed, and which is equally uſed in buildings. It is ſchiſtous, and eaſily ſeparates into large flakes. The mica, which is of a ſhining black, inſtead of being diſperſed within it in ſeparate ſcales, extends in broad leaves, placed one over the other; and the quartz and feltſpar are frequently diſtributed in flakes.

This granite loſes its ſolidity in the fire, without fuſion; but the mica, and feldſpar ſhew evident ſigns that they have been ſoftened.

III. Granites of the Italian Apennines. Though a conſiderable part of the Alps which ſurround Italy, abound with theſe rocks of the firſt formation, they are very

rare

rare in the Apennines, which are principally formed of calcareous ſtone, ſand ſtones, and ſteatites. In the various excurſions which I have made to different parts of them, I have rarely found this ſtone, and never but in very ſmall quantities, and detached pieces, without being able to diſcover whence they came. In the ſpring of the year 1790, I collected ſome of theſe ſcattered pieces, in the river Staſora, at the foot of a hill, a few miles from the town of Voghera. They were of three ſpecies: the following are the diſtinguiſhing properties of the firſt.

Its conſtituent principles are four; the quartz, of the colour of water, ſcattered in ſmall but numerous pieces; the black mica, in few, and extremely minute flakes; the feltſpar, rather abundant, and of the colour of honey; and very ſmall ſhoerls, included within the feltſpar.

The pieces, except that they adhered together,

gether, retained, when they came out of the fire, the ſame figure they had before, though the feltſpars were a little, and the ſhoerls entirely, fuſed.

The ſecond of theſe granites, with reſpect to its component principles, is ſimilar to the common, conſiſting of mica, feltſpar, and quartz; but it is one of the hardeſt and moſt beautiful that I have ſeen, and takes a very elegant poliſh.

In the fire the quartz becomes almoſt pulverulent, the feltſpar aſſumes a ſlightly enamelled ſurface, and the fuſion of the black mica covers the pieces with a thin coating which has an unctuous appearance.

The third granite has for its component principles, ſemi-tranſparent quartz in ſmall and rare grains, and feltſpar in large and numerous particles.

In the furnace, the quartz becomes friable; but in the feltſpar, we only perceive ſigns that it is ſoftened.

IV. In

IV. In Chapter XI. I have mentioned an Egyptian porphyry which was expoſed to the fire. I ſhall now add that this ſtone, from porphyritic that it was, became, in many places, granitous. In conſequence, therefore, of forcible ſeparation, or inſenſible alteration, the maſs of porphyry may be loſt, and ſucceeded by the granite, compoſed of ſhoerls, abundant feltſpars, and argillaceous particles.

In the furnace, this granite imperfectly fuſes into an ebullient ſcoriaceous enamel.

V. This granite, as it contains ſulphure of iron, and red ſulphurated oxyde of mercury (cinnabar), merits a particular deſcription. It forms a mountain in the diſtrict of Feltre, in the Venetian territory; to the eaſt of which lies the *Valle Alta*, to the weſt the *Acqua Pezza*, to the ſouth the *Boſco delle Monache*, and to the north *Vallone*. Some years paſt, this rock was dug into, and perhaps is ſtill; not to employ it in building;

but

but to extract the mercury with which it is impregnated; and of which it furniſhes fifteen parts out of a hundred. This intereſting information I received from Signor Franceſco Antonio Tavelli, ſtudent of natural hiſtory, under whoſe directions theſe excavations were undertaken, in the year 1786. He furniſhed me with ſeveral fine ſpecimens of this rock, which I immediately perceived to be granite. Its component parts are quartz, in cryſtallized grains; felt-ſpar, in lamellar, ſemi-tranſparent, whitiſh ſcales; and ſteatites. The latter does not form a paſte, or common cement, which conglutinates the quartz and feltſpar, but is diſtributed in ſuch a manner, that theſe three conſtituent parts adhere together ſolely by the force of attraction. The ſteatites is ſoft and ſchiſtous, and of a dark green colour. This is the only part of the granite to which the ſulphur has penetrated; to free it from which, it is neceſſary to break it into ſmall pieces. The ſulphur, therefore, has ſometimes mineralized the mercury, and ſometimes the iron. Some parts, however,

of ſeven or ten lines, and frequently even an inch and a half, or two inches, in thickneſs, are of a lively red, though the ſteatites has loſt its peculiar texture; and theſe parts, as they abound moſt with mercury, are the heaviest. The reſt, on the contrary, are lighter, as they contain a leſs quantity of this metal; and hence, likewiſe, their colour is of a deeper or paler red. In the midſt however of this diverſity of tints, the feltſpar and quartz ſeem to have been impenetrable by the ſulphur, and, in the reddeſt places, ſtill preſerve their natural colours and reſpective degrees of tranſparency. But in other parts of the ſteatites, the ſulphur has mineralized the iron, producing ſulphure of iron. This is of a braſſy yellow, and ſufficiently ſoft to decompoſe in the air, efflorescing, and emitting ſulphate of iron (vitriol of iron). About four years ago, I received from Signor Tavelli at Venice, ſome pieces containing this ſulphate, which I put into a box; and a few months after found them to be broken, and covered with a yellowiſh efflorescence. When touched

with the point of the tongue, they occalioned a ſtrong aſtringent taſte, from the preſence of this ſulphate (vitriol), which, in fact, is likewiſe procured from that rock.

When this granite came out of the furnace, the ſteatites and the feltſpar were blended into one porous ſcoria, but the quartzous grain remained unfuſed.

VI. The experiments on numbers IV. and V. are, however, leſs to the purpoſe, ſince if we ſhould compare, by the means of our common fires, the granites which are found fuſed at Baſiluzzo and Panaria, the conſtituent parts of which are feltſpar, mica, and quartz; and the natural granites; the latter muſt neceſſarily be found to conſiſt of the ſame principles. I have already, as has been ſeen, made the proof with ſeveral, nor did I neglect to do the ſame with five other ſpecies, which I do not deſcribe that I may not tire the reader. I ſhall only ſay, in general, that the quartz was always infuſible; the mica, in two inſtances, melted; and the

feltſpar, every time, gave ſigns of a beginning liquefaction; which occaſioned the pieces in the crucible to adhere together, but without forming a conſolidated whole, as is the effect of complete fuſions.

VII. As M. Dolomieu has remarked that the Eolian iſles have a part of their baſe of granite, I endeavoured to diſcover from what places it might derive its origin; and, after ſeveral laborious reſearches among the mountains of Sicily, concluded that it proceeded from rocks of the ſame ſpecies, extending to the mountains of *Capo di Melazzo*, which are in part formed of granite, and have likewiſe their direction towards this iſland.

In my paſſage from Lipari to Meſſina (a diſtance of about ſixty miles) I made ſome ſtay purpoſely at this cape, which lies about the mid-way, judging it to be of importance to examine the nature of the place; and I, in fact, found there granite.

Mica,

Mica, ſometimes black, and ſometimes of a ſilver colour; blueiſh, and ſometimes milk-white quartz; and reddiſh or whitiſh feltſpar, are the three component parts of this granite, ſometimes diſtributed nearly equally, and ſometimes in very unequal portions. Sometimes, though rarely, the mica is hexagonal; and the feltſpar ſhews a beginning cryſtallization.

This granite is not found in ſtrata, but large maſſes, which form a conſiderable part of Cape Melazzo and its environs, and in many places extend quite to the ſea. Here, likewiſe, we diſcover, under the water, the ruins of a very ancient edifice, built of this ſtone.

As, therefore, it appeared extremely probable that this granite was the ſame with that of which Panaria and others of the Lipari iſlands are compoſed, it was more particularly requiſite that the ſame experiment ſhould be made on it in the furnace, which had been made on the other ſpecies;

and ſince the proportions of its three elementary parts varied in it, I took five varieties, and placed ſmall pieces of each in ſeparate crucibles.

The reſult was, that the mica became more fragile, the feltſpar exhibited ſome ſigns of fuſion, and the quartz loſt its tranſparency and became full of flaws. The pieces, however, all retained their original form.

VIII. In Panaria, and ſome parts of Baſiluzzo, are found pieces of granite, in which the fire appears not to have cauſed the leaſt alteration; and yet there is every reaſon to believe that they have been thrown out of the mouths of volcanos, though they are ſtill in the natural ſtate in which they are found in the bowels of the earth. This granite in its three conſtituent principles, and the qualities of each of them, extremely reſembles that of Melazzo. It likewiſe reſembles it in its reſiſtance to the fire, as only ſome traces of fuſion in the feltſpars are obſervable.

IX. Laſtly,

IX. Laſtly, I made ſome experiments on certain ſpecimens of granitous lavas, which have formed currents at Panaria and Baſiluzzo; but the reſult was not more ſucceſsful than with the other granites: they entirely reſiſted the fire, except that the felt-ſpar was in ſome places thinly covered with a kind of enamel varniſh. This was one of the very few lavas which was not fuſible in the glaſs furnace.

Theſe facts ſufficiently prove that theſe granites, ſuch at leaſt as are compoſed of quartz, feltſpar, and mica, are infuſible in a heat of $87\frac{1}{3}$ degrees of the pyrometer of Wedgewood, though continued in it for forty-eight hours; a heat which, as has been ſaid, is only $2\frac{1}{2}$ degrees below that in which iron begins to fuſe, which is at 90 degrees of the ſame pyrometer. I determined, therefore, to expoſe theſe ſtones to that degree of heat, or even a greater, having recourſe to a wind-furnace in which iron is completely melted. In this, in leſs than an hour, a fuſion took place which was perfect

or little leſs in the feltſpars, and beginning and ſometimes complete in the mica; but the quartz ſhewed no ſigns of liquefaction. When, therefore, the quantity of the feltſpar was greater than that of the two other component parts, the pieces in the crucible formed one ſingle maſs, with a ſmooth ſurface, either even, concave or convex, in the ſame manner as in the fuſion of lavas. The maſs, however, was not homogeneous. The feltſpar, whatever was its colour, became of a milky whiteneſs, extremely ſmooth and ſhining, and conſiderably harder. It is remarkable that the mica which, in ſome granites, was of a ſilver whiteneſs, and in others of a gold colour, is changed in conſequence of its fuſion to a deep black*.

Theſe

* I ſhall here add a remark which I had intended to make in the introduction to this work, but which will not be improperly placed here. As in theſe fuſions I made uſe of crucibles of clay, it may be objected to me, that I am not certain whether the ſubſtances on which I made my experiments were fuſible in themſelves, or in conſequence of their combination with the clay of the crucible. But I anſwer, in the firſt place,

Theſe experiments when compared and conſidered muſt lead us to conclude that the fuſion of granites requires a very violent heat; and with theſe experiments likewiſe agree thoſe made on ſtones of the ſame kind by MM. D'Arcet, Gerhard, and Sauſſure. I have ſaid *in general*, ſince I do not deny that, in a leſs intenſe fire, the fuſion of the feltſpar may be obtained, in ſome ſpecies of granite, which may draw after it that of the quartz*. Though in the almoſt endleſs varieties

place, that this combination rarely happened; and that when it did, it was too conſpicuous not to be perceived, as the crucible was more or leſs corroded. Secondly, that I did not form my judgment of the fuſibility of the ſubſtances I examined, from the parts of them in contact with the crucible, or at a little diſtance from its ſides; but from thoſe near the middle, where, from the diſtance, this combination could not have place, as the circular mouth of the crucibles I uſed was two inches in diameter. When, therefore, I ſpeak of the fuſion of any product, I conſider myſelf as perfectly certain that the clay of the crucible had no part in it.

* Morveau, in a letter to the Comte de Buffon, writes, that two pieces of different kinds of granite, being placed ſeparately in the crucible, in leſs than two hours

rieties which I fuſed and have deſcribed in this work, the feltſpars in general were refractory; yet they ſometimes eaſily melted in the furnace uſed at Pavia for the manufacture of common glaſs, the heat of which, as has been ſaid, is much leſs than that employed in making the cryſtal glaſs. This has been proved in the feltſpars of the lavas of Iſchia, which, whether mechanically united to other ſubſtances, or ſingle, completely fuſe*. The facility with which ſome few feltſpars melt, and the refractorineſs of others, I have found to proceed from the different quantity of ſilex they contain combined with other earths, which is ſmall in the former, and very abundant in the latter. If, therefore, a granite which has for its baſe the feltſpar contain but a ſmall portion of ſilex, there is no doubt but its fuſion may be obtained with a moderate heat. It is, how-

hours melted into a homogeneous glaſs (Buffon Miner. T. I. in 12.): but he neither ſpecifies the conſtituent parts of the two granites, nor the degree of heat neceſſary to fuſe them.

* See Chap. V. near the end.

ever,

ever, certain, from the experiments above adduced, that completely to fuſe the feltſpar in the granite of Cape Melazzo, and in the detached pieces of a ſimilar kind found at Panaria and Baſiluzzo, as alſo that which conſtitutes the baſis of the lavas of theſe two iſlands, not to mention other ſpecies which have been enumerated, a very ſtrong heat is neceſſary, and equal to that required to melt iron.

It hence appears to be ſufficiently proved that the volcanic fires which have produced Baſiluzzo, Panaria, and the other neighbouring iſlands, muſt have been extremely violent; the importance of which deduction will more diſtinctly appear when we come to conſider the queſtion relative to the activity of volcanic fires in general.

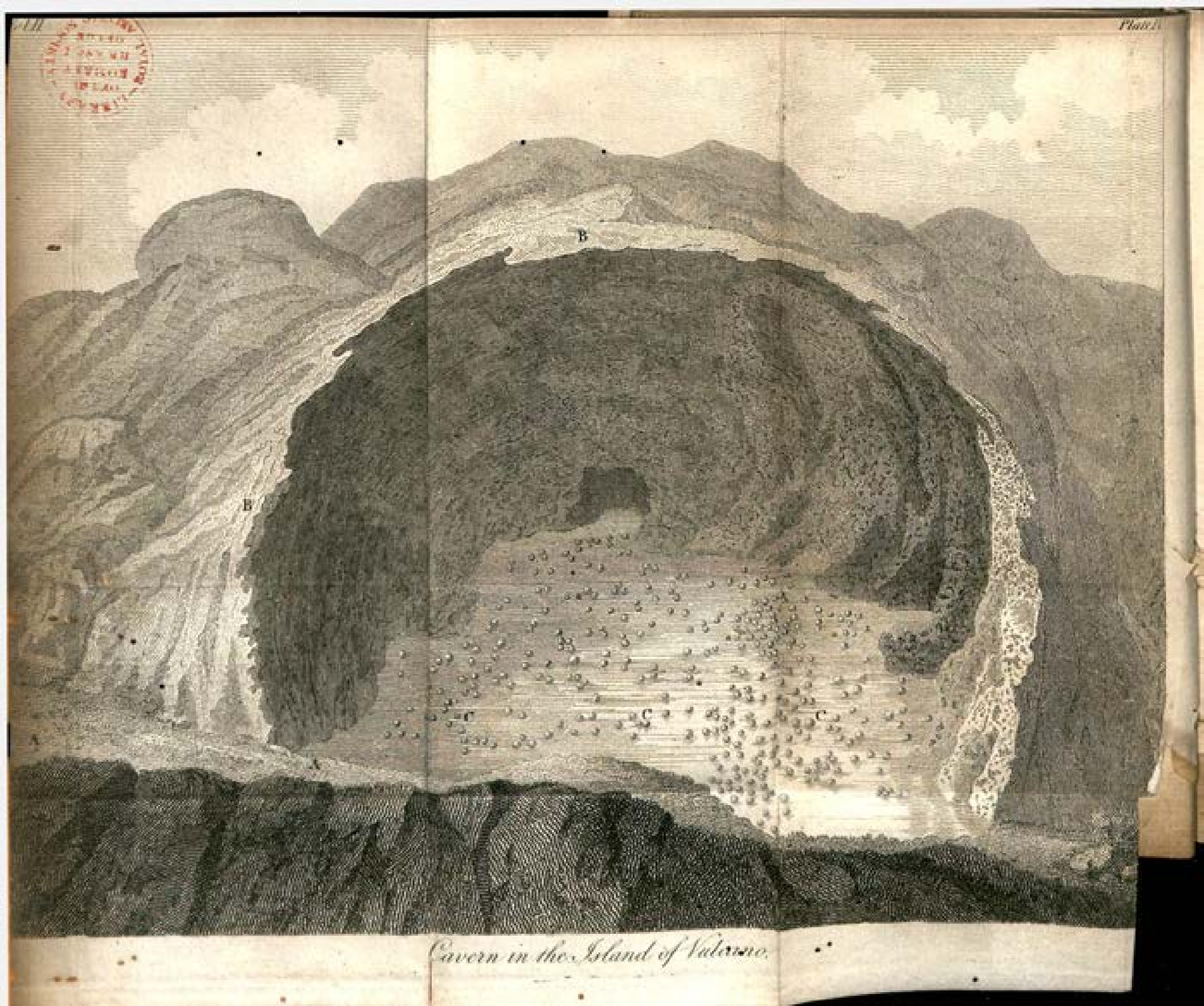
CHAP.

CHAP. XIII.

VULCANO.

Different parts of this island distinctly visible from the summit of the Monte della Guardia, in Lipari—Shore of the island entirely formed of volcanic productions—Vulcanello, a small island, once separated from Vulcano, but long since united to it by an eruption—Two singular lavas of Vulcanello—Its crater—Surrounded by sulphureous fumes and hot exhalations—Lumps of sulphur found in the earth through which these fumes pass—Grotto celebrated for a medicinal water which it contains, and other peculiarities—Summit of the mountain scattered over with vitreous lavas, pumices, and glasses—The transition of the pumice into glass distinctly observable—Hot sulphureous exhalations on the side of the mountain, which has the figure of a truncated cone—The stones found there, whitened and de-

composed



Cavern in the Island of Vulcano.

Vulcano.

compoſed—Other ſimilar fumes higher up the mountain—Subterranean noiſe heard there; with a ſhaking of the earth when ſtruck with the foot—Sulphur formerly extracted at Vulcano by the Liparese, and purified on theſe heights—This profitable labour now abandoned, and why—New ſulphur re-produced where it had been dug up—The larger crater of Vulcano ſituated at the ſummit of the truncated cone—Deſcent of the Author into the crater—Its interiour deſcribed—Subterranean noiſe heard at the bottom of the crater—Wind which blows at the bottom generated by ſulphurated hydrogenous gas—Extreme heat of the bottom—A kind of hill in the middle of it exhaling a quantity of vapours, and incruſted with various minerals—Reverberated ſound produced in it by the falling of a ſtone—Gulph immediately under it in which a ſtrong fire burns—Blueiſh ſulphureous flames ſeen by night riſing from this bottom—A cavern of conſiderable ſize hollowed in the ſides of the crater, which deſcends to the bottom—Objects moſt deſerv-

ing notice in this cavern—Glaſſes and pumices of this volcanic bottom decompoſed by ſulphureous acids—Priſmatic or baſaltiform lavas, which derive their origin from fire, diſcovered within it—Erroneous opinion of M. Sage that the decompoſition of the lavas, and other volcanic productions, is to be aſcribed to the muriatic acid—Demonſtrative proof that theſe decompoſitions are the effect of ſulphureous acid vapours—Incidental notice of another error of that chymiſt, relative to the Grotta del Cane, near the lake Agnano.

AS from the top of a lofty tower which overlooks a ſpacious and noble city, we command a perfect view of the latter, its circuit and extent, its lofty and ſumptuous palaces, and its numerous edifices; in like manner, from the ſummit of the Monte della Guardia, one of the higheſt mountains in the iſland of Lipari, we contemplate with aſtoniſhment the circumference, the maſſy body, and the various diſtinct parts of the neighbouring Vulcano.

To this mountain I, therefore, repaired, expreſsly to take a comprehenſive view of the iſland previous to my viſiting it; in which, beſides the courſe and inclination of its rocks and cliffs, its craters are clearly perceivable, and it may be diſtinctly ſeen that the form of the larger is that of a truncated cone. The white fumes, which aſcend from it, are likewiſe very viſible by day, while by night the atmoſphere above the crater aſſumes an obſcure redneſs. Here, too, we may moſt diſtinctly perceive the junction of Vulcano to Vulcanello; which latter, as is well known, was anciently an iſland, ſeparated from Vulcano by a narrow arm of the ſea, that has ſince been filled up with earth by a violent eruption. The new land which has joined the iſlands may be very clearly ſeen, and appears to be formed of a ſterile ſand. The two ſmall havens at its extremities, one of which is called the eaſtern, and the other the weſtern, are, likewiſe, diſtinctly viſible.

Such was the anticipated pleaſure afforded me

me by this mountain, which was afterwards ſtill more increaſed, and accompanied with ſtill greater inſtruction when I coaſted the iſland in a boat. Its ſhore is about eleven miles in circuit, and every where preſents to the eye the traces of fire, in the remains of ſtreams of lava, enamels, vitrifications, puzzolanas, and pumices.

Vulcanello has long made a part of Vulcano, but is ſtill perfectly diſtinguiſhable from it by the interpoſed land. It has the form of a ſcalene triangle, two ſides of which ſink abruptly into the ſea, and merit examination more than any other parts of the ſhore. They conſiſt of many ſtrata of lava, ſeveral feet high, and piled one above the other. When they flowed, they muſt certainly have extended farther into the water; but they have been broken, gradually, by the violence of the waves; and their fractures now form a kind of wall of a great height, which deſcends perpendicularly into the ſea. As the water here is ſhallow, the bottom may be ſeen ſcattered over with large

large pieces of theſe lavas; and the wall, on a near approach, preſents to the eye a number of currents of lava, which have flowed at different times, and differ in their colour, component parts, and conſiſtence.

The appearance of theſe currents of lava, which have flowed one over the other, reminded me of what I had obſerved ſeveral years ago, in the glaciers of Switzerland; where ſome parts of the ſnowy coating being broken, the different ſtrata of ſnow, which had fallen at different times, are diſtinctly diſcernible by the difference of the colour.

As the greater part of theſe lavas differ very little from thoſe of other volcanos, I ſhall not give a deſcription of any of them except two only, which appear to me not to be common.

The firſt lies buried in the midſt of the

others, and would, therefore, only become viſible by cutting them away, did not the ſuperincumbent lavas, which are in ſeveral places broken, diſcover it in thoſe fractures. In its ſuperficial parts it is a true enamel, very black, and ſhining, entirely opake, which eaſily crumbles, and in which are incorporated many ſhoerlaceous and felt-ſpathoſe ſcales. This enamel contains tumours marked with ſtripes and large threads, which appear every where in it, but always run in the ſame direction, which is that of the courſe of the lava, or from the mountain to the ſea. The ſubſtance of theſe ſtripes and threads is likewiſe enamel. Their preſence and direction ſufficiently indicate that the enamel when it flowed and entered the ſea was rather of a ſoft conſiſtence than fluid.

I at firſt imagined that, as the other contiguous lavas were each of one ſubſtance through the whole of their depth, it muſt be the ſame with this enamel, as far as it formed

formed a diſtinct current, as we ſhall ſee in the enamels of Lipari; but on breaking ſome of the larger pieces, I found that this was not the fact. The enamel is only the ſuperficial part, or cruſt, of a lava, many feet deep, which cruſt, where it is thinneſt, is ſcarcely more than a line in depth, but where thickeſt frequently more than two inches. It cannot, however, in any manner be conſidered as a later product, or as having flowed after the lava and attached itſelf on it; this cruſt of enamel is certainly a true continuation of the lava itſelf, as I have, in my opinion, ſatisfactorily aſcertained by repeated and careful examinations. The enamel, therefore, after having formed this cruſt of greater or leſs thickneſs, ſuddenly loſt its diſtinctive characters, and changed into a lava of a reddiſh grey colour, dry, rough to the touch, earthy, emitting an argillaceous odour, and having for its baſe the hornſtone, without loſing its ſcales of ſhoerls and feltſpars. We muſt hence conclude that the current was more affected by the fire on its ſurface than in its internal

parts; for I know no other mode of explaining this phenomenon.

From this enamel and lava, when expoſed to the furnace, reſults a ſimilar enamel; that is to ſay, one of a dark grey colour, very hard and compact; with a fuſion of the ſhoerls, and a ſemi-fuſion of the feltſpars.

Another product with a hornſtone baſe, of a very ſingular quality, and which I do not remember to have ſeen any where elſe in my volcanic travels, is found on one of the ſides of Vulcanello that deſcend perpendicularly into the ſea, and, having been broken in different places by the violence of the waves, preſent upon the ſhore, and within the water, a large heap of fragments of a globular form. At the firſt view it might be taken for a tufa. It is rather light than heavy, may be crumbled to powder between the finger and thumb, imbibes water, with which it is in a few moments ſaturated, with a kind of hiſſing ſound, and emits an argil-

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laceous odour. We know that ſimilar properties are uſually found in volcanic tufas: but theſe have an earthy grain, whereas the preſent ſubſtance rather inclines to the vitreous. Beſides, when the ſhoerls it contains, which are innumerable, are examined, they are found to be diſtributed equally, as they uſually are in lavas—a diſtribution never met with in tufas, in which the ſhoerls that are ſometimes found in them are ſcattered confuſedly and at random. Hence, as they are extraneous bodies, they are eaſily detached from the tufaceous maſs; but this is not the caſe with the product in queſtion, which, conſequently, we muſt conſider as a true lava.

But to what are we to attribute its ſoftneſs? Perhaps it has been conſiderably changed on the ſurface by ſulphureous-acid vapours, by length of time, or ſome other unknown cauſe. Such, at leaſt, was the firſt idea which preſented itſelf to my mind, but which I found inadequate, both becauſe in that place no ſulphureous fumes exhale, nor are

there any indications that any ever have exhaled; and, becauſe, having procured this lava to be dug up from the depth of five feet, I found it, there, extremely ſoft as well as at the ſurface. I am rather of opinion that this lava is the reſult of the combined effect of fire and water; as examples are not wanting, in volcanized countries, of ſimilar combinations. I mean that the lava, while flowing, was met and penetrated by a ſtream of water, that had guſhed from ſome aperture of the volcano, by which it was ſuddenly cooled, and loſt that coherence which is uſually the property of lavas. I found this opinion on ſeveral obſervations. I perceive that the lava has a number of cracks and fiſſures, ſuch as are uſual in ſtoney ſubſtances which, while in a ſtate of fuſion, have come into contact with water. I obſerve that the ſhoerls, which in other lavas have the hardneſs of glaſs, are in this ſo friable that they may be ſcratched with the nail; and as ſuch appearances are not uſually the effects of volcanic fire alone, I know not to what to aſcribe them but to

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the action of water; ſince vitreous ſubſtances in a ſtate of fuſion are affected in preciſely the ſame manner by contact with that fluid.

The ebullient though hard enamel, which is the reſult of this lava in the furnace, is of a fine deep black; the ſhoerls are melted; and it is worthy remark that in it we diſcover ſome ſmall flakes of white feltſpar which before were not diſcernible in the lava on account of its cinereous colour.

The two lavas I have deſcribed, as likewiſe others of which I have omitted the deſcription on account of their being common, and which together form the two ſides of Vulcanello, appear by their direction all to have proceeded from the crater, which is about two hundred paces diſtant from the ſea; and which ſtill retains its natural figure of an inverted tunnel, except that the bottom is covered to ſome height by earth which has been carried down by the rains from the internal ſides. Theſe

ſides are formed of pulverized clay and ſand, and are marked with deep furrows cauſed by the deſcent of the rain-water. The circumference of the bottom of the crater, judging by the eye, cannot at the utmoſt be more than ſeventy, but that of the top is about the ſixth of a mile. Its depth is ſcarcely eighty feet. The crater on the outſide is ſurrounded with rocks of lava, probably the conſequences of an eruption. It is evident that, as more earth is continually falling into it, it muſt at laſt be filled up; and as the external ſides of it are ill-formed, there is no doubt but that one day every trace of it muſt be loſt. We hence perceive how many volcanized countries may appear, and in fact do appear, to be deſtitute of craters; theſe not having been able to reſiſt the injuries of time.

Here was it that I began to perceive the indications of the ſubterranean burning furnace; for round the crater of Vulcanello many ſtreams of a white ſmoke ariſe; and it is only neceſſary to ſtrike the ground with the

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foot to produce more. They are very hot, as are likewiſe the apertures through which they iſſue, and which, in the night, from time to time, emit a feeble flame. The ground, which fumes at the ſurface, within, contains cruſts of ſulphur, which are moſt abundant in the places where the fumes exhale moſt copiouſly. But we ſhall ſoon have occaſion to treat more at length of the ſulphur of this iſland.

From Vulcanello I proceeded to a grotto which has obtained ſome celebrity on account of a mineral water it contains, and is at the diſtance of about a mile from the weſtern haven. To reach this water, it is neceſſary to deſcend into the grotto, the entrance of which is ſo narrow, that you are forced to ſtoop very much, and almoſt creep on the hands and knees. It is a moderately large cavern, incruſted round with ſulphate of alumine (alum), muriate of ammoniac (ſal-ammoniac), and ſulphur. Theſe minerals are found to be very warm, as likewiſe is the atmoſpheric air in this place,

on account of the heat of which, the ſtrong ſulphureous ſmell, and the difficulty of reſpiration, it is impoſſible to remain long in the grotto, which you are obliged to leave from time to time, to breathe freſh air. At the bottom is a ſmall pool of very warm water, which is eſteemed by the Lipareſe to be efficacious in many diſorders. The Abbate Gaetano Trovatini, a learned phyſician of Lipari, has publiſhed an analyſis of this water*. I ſhall not therefore enter into a minute account of it, which would be ſuperfluous, but ſhall only remark that, beſides the ſulphureous odour it emits, it contains abundantly the muriate of ammoniac (ſal-ammoniac), and ſtill more of the muriate of ſoda (ſea-ſalt); which latter ſalt I imagine it derives from a communication with the neighbouring ſea, with which it appeared to me on a level. Though its temperature is not higher than 80 degrees, it continually appears to boil, from the great number of air bubbles that riſe from the bottom to the ſurface, which they

* Diſſertazione chimico-fiſica ſull' analiſi dell' acqua minerale dell' Iſola di Vulcano. Napoli 1786.

entirely

entirely cover. This water, in fact, ſo much abounds with this aëriform fluid (which I found to be carbonic acid gas), that when ſhaken in the ſlighteſt manner a prodigious quantity of bubbles ariſe. I likewiſe obſerved, relative to the ſame object, that if a ſtone be let fall into this water, as it ſinks, a vaſt quantity of theſe bubbles will aſcend, and will continue to ruſh to the ſurface ſeveral minutes after it has reached the bottom. The continual emiſſion of ſo much carbonic acid, which doubtleſs concurs to render the air in the cavern unfit for reſpiration, produces within the grotto a confuſed noiſe, which may be heard likewiſe without.

M. Dolomieu, in his account of this ſubterraneous place, obſerves that a conſiderable quantity of ſmoke iſſued from it. This, when I was there, I could not perceive; either becauſe it had opened to itſelf another paſſage, or that the cauſe by which it was produced has ceaſed: changes not unfrequent in volcanic countries.

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This cavern is repreſented in Plate IV. A A is the narrow entrance, B B B the top and ſides, and C C C the ſmall pool, full of air bubbles.

To this place, the aſcent of the iſland is gradual; but the remainder of the way which leads to the higheſt crater of Vulcano is extremely rugged and difficult; as it lies over a long mile of continued heaps of lavas, vitrifications, and pumices. The fatigue, however, is alleviated by the pleaſure which the inſtructive examination of theſe productions affords. Some of the vitrifications found among the lavas clearly manifeſt, that they were originally pumices, which, by a more intenſe heat, have paſſed into the nature of complete glaſs. The breaking of ſome of them proves this beyond the poſſibility of a doubt. We then find one part a common pumice; I mean reſembling threads of ſilk, light, extremely friable, floating on water, and of a very white colour. Another part we find to be vitreous, of a different texture, leſs filamen-

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tous, leſs light, leſs white, and leſs friable. Still farther, begin to appear long veins or threads of glaſs, which continually increaſe in thickneſs; and, at laſt, in another part of the piece, multiply and conſolidate into a maſs completely glaſs. This glaſs is ſemi-tranſparent, of a colour between grey and black, and ſo hard as to give ſparks with ſteel.

It is worthy of remark that ſome of the black ſhoerls, and white feltſpars, incorporated in the pumice, are preſerved entire in this glaſs.

The furnace melts neither of theſe; though it completely fuſes the glaſs, which is changed into an extremely porous enamel.

Mixed with theſe curious combinations of glaſs and pumice are found true glaſſes, and true pumices, as alſo a variety of lavas, which, having loſt, in a conſiderable degree, the texture of their primitive rocks, have

have acquired a vitreous appearance. They are extremely compact, give ſparks with ſteel, are of a blackiſh or dark blue colour, and are not wanting in feltſpars and ſhoerls. Some of them will move the magnetic needle at the diſtance of three quarters of a line. One of them has become a volcanic breccia, as it contains within it fragments of other lavas which it enveloped while in a ſtate of fuſion. Theſe fragments are of a coarſe grain, and a ſpongy texture, and when minutely examined are found to derive their origin from the hornſtone, while that of the including lava is from the petroſilex. The ſame difference continues even in the furnace; the fragments becoming ſcoriaceous, and the lava a ſemitranſparent glaſs.

Theſe glaſſes, pumices, and lavas, do not form currents, but are found in large maſſes; and it is probable that they were thrown out of the mouth of the volcano in the ſame ſtate in which we now ſee them.

As we proceed up this difficult aſcent, we perceive, near the top of the truncated cone, five or ſix ſtreams of ſmoke, approaching which we find that each of them iſſues from an aperture incruſted round with ſmall cryſtals of ſulphur. If a ſtick be thruſt into them, and drawn out again ſoon after, it will appear black, and ſmoke. The earth is here extremely hot, every ſtone is decompoſed, and of a white colour; and if new apertures are made with a ſtaff (which may eaſily be done from the great ſoftneſs of the ground), new fumes will immediately iſſue ſimilar to the other; that is to ſay, white, very offenſive from their ſulphureous ſmell, and extremely hot.

Above theſe fumes there is a plain, of no great extent, which one is, at firſt, afraid to venture on, from the ſubterranean noiſe heard there, and from the ſhaking of the ground when ſtruck with the foot. Here we find other ſulphureous fumes, beſides ammoniacal vapours, which, attaching to the

the decompoſed lavas, generate thin cruſts of that ſalt.

On this plain it was, that, formerly, ſtood the furnaces in which the ſulphur of Vulcano was purified. But this uſeful labour has been long ſince abandoned, and even prohibited, from the ſuppoſition that the vapours ariſing from the purgation of the ſulphur were prejudicial to the plantations of vines in Lipari. A few years ago, indeed, it was again reſumed, by the ſpecial permiſſion of his Sicilian Majeſty; but was ſoon again given up, not becauſe any fear was then entertained that the vines would be injured, which the more judicious of the natives of Lipari are now convinced is a vulgar error, ſince they ſuſtain no damage from the ſmoke of the crater of Vulcano itſelf, though that is beyond all compariſon more in quantity than that produced by the purification of the ſulphur: nor was it abandoned becauſe the quantity of ſulphur obtained was too little to repay

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the trouble and expence, as the vein is very rich and even inexhauſtible; for wherever the ground about the craters of Vulcano and Vulcanello is but ſlightly turned, fine clods of ſulphur are found; which are larger and more numerous the deeper the earth is dug into. My own obſervations have in this particular ſufficiently confirmed the teſtimony of the people of Lipari: as I was convinced, in my different viſits to the iſland, that in the very places from which the ſulphur had been extracted, after a ſhort time it is re-produced.

The real cauſe why the inhabitants of Lipari no longer continued this work was, that the ground, which on the ſurface is more or leſs warm, grows hotter the deeper it is dug into, and, at the depth of five or ſix feet, becomes ſo hot as to be almoſt inſupportable; to which is to be added the offenſive ſtench of the ſulphureous fumes that iſſue in great abundance from theſe excavations. If this mineral was once extracted here to great advantage, as we are

aſſured by hiſtory, it ſeems certain that theſe difficulties could not then exiſt.

Continuing my journey towards the ſouth from theſe forſaken furnaces, and having mounted a ſhort but ſteep aſcent, a ſecond, but a much more ſpacious plain opened before me, which was every where ſandy, except that a few erratic layas were thinly ſcattered over it. Beyond it roſe a conſiderable eminence, which when I had aſcended, the nobleſt ſpectacle Vulcano can offer preſented itſelf to my view, I mean its crater. Except that of Etna, I know none more capacious and majeſtic. It exceeds a mile in circuit, the mouth is oval, and its greateſt diameter is from the ſouth-eaſt to the weſt. This mountain externally has the form of a direct cone, and its crater that of a cone inverted. The height of the internal ſides from the bottom to the top is more than a quarter of a mile. From the top, the bottom may be ſeen, which is flat, and from many places in it exhale ſtreams of ſmoke,

that riſe above the crater, and emit a ſulphureous odour which may be perceived at a conſiderable diſtance.

After having made the circuit of the upper circumference of the crater, I became deſirous to enter it, and deſcend to the bottom, to examine the internal parts; the ſouthern ſide, which is not very ſteep, appearing to invite to ſuch an examination. I was not willing however to undertake ſuch an adventure alone, but wiſhed for ſome one to accompany me, who might ſerve me as a guide, and, I may likewiſe add, who might keep up my courage. But my wiſhes were vain. The four ſailors who had worked the boat which brought me to the iſland, and had gone with me to the edges of the crater, when they found I entertained thoughts of going down into it, poſitively refuſed to follow me, alledging the evident danger to which I ſhould be expoſed, and adducing the example of I know not what traveller, who, a few years ago, having deſcended into this deep gulph,

paid for his temerity by never coming out again. All my entreaties, therefore, and all offers of reward were fruitleſs; and I was obliged to return to Lipari without having been able to gratify my wiſh. Theſe ſailors were natives of Lipari, nor could I find any of their countrymen who would hazard accompanying me in making this experiment. So great is the dread they are inſpired with by this volcano, proceeding, probably, from the fame of its ancient terrors, and alſo from ſome recent eruption, of which we ſhall hereafter have occaſion to ſpeak.

A reſolute Calabrian, who had been baniſhed to Lipari for ſome crime committed at Naples, was the only one, who, with the permiſſion of the Marcheſe Chiavelli, the governor of that city, and the promiſe of a large reward, could be induced to go down with me into the crater. We deſcended on the 13th of September 1788. I have already ſaid that the ſides towards the ſouth-eaſt are not very ſteep, and on this

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ſide we therefore ſafely reached the bottom, where I proceeded to make ſuch obſervations as I thought of moſt importance. I here perceived, more diſtinctly than I could above, that the crater was a hollow cone reverſed, but truncated by the bottom on which I ſtood. The ſides, except in that part where we deſcended, are every where inacceſſible. As they are covered with ſand, they are marked with deep furrows which are the effect of rains.

The bottom on which we ſtood, may be about ſomewhat more than a third of a mile in circumference. It is covered with ſand, like the ſides, and in form an oval. I ſoon perceived that it could not be walked over without danger, and that it was neceſſary to uſe the greateſt circumſpection in examining it. I have already mentioned the ſubterraneal noiſe heard on approaching the crater of Vulcano. Here it may be ſaid to be a hundred times louder. Under this bottom we ſeem to hear a river running, or rather a conflict of agitated

waves which meet, and impetuouſly claſh together. The ground, likewiſe, in ſome places, cleaves in cracks, fiſſures and apertures, from which hiſſing ſounds iſſue reſembling thoſe produced by the bellows of a furnace. I therefore thought there was every reaſon to conclude, that theſe ſounds are occaſioned by an elaſtic gas which iſſues through thoſe fiſſures; and was afterwards perfectly convinced of the truth of this ſuppoſition by the following facts. If the hand be approached to any of theſe cleſts or apertures, a ſtrong impreſſion is felt of an extremely ſubtle inviſible fluid; and, if a lighted candle be applied to them, it will, it is true, be frequently extinguiſhed by the impetus of the fluid, but ſometimes it will ſet fire to the fluid itſelf, producing a flame of a blueiſh-red colour which laſts for ſeveral minutes. The fetid odour which is then perceived convinced me that it is a ſulphurated hydrogenous gas.

The ground at the bottom was ſo hot that it burned my feet; and I ſhould not long have

have been able to endure its heat, had I not, from time to time, got on ſome large pieces of lava which were not ſo hot. From the extreme heat, and the ſtrong ſtench of ſulphur emitted by every part of the bottom, ſo as to render reſpiration ſomewhat difficult, I could ſcarcely go round it, and it was quite impoſſible to croſs it near the middle; at leaſt it would have been very dangerous to have attempted it. About the middle of this bottom aroſe a circular eminence, of about forty-five feet in diameter, from every part of which a denſe vapour ſublimes, and the ſurface is covered with cruſts of ſulphate of iron (vitriol of iron), ſulphate of alumine (alum), muriate of ammoniac (ſal-ammoniac), and ſulphur; as I found by collecting and examining ſome fragments of theſe cruſts at the edges of the eminence. Its heat is inſufferable; and on preſſing the edge with my feet I perceived it ſhake very ſenſibly, as if I had trod on a floor of boards which yielded and ſprung up again under me. On letting fall a large piece of lava from the height of my

body, a ſubterraneous echoing ſound was heard, which continued ſome ſeconds; and this happened on whatever part of the bottom the piece of lava was let fall, but the ſound was loudeſt near the eminence in the middle. Theſe circumſtances ſufficiently proved that, while on this bottom, I walked over a gulph from which I was only ſeparated by a flooring of volcanic matters of inconſiderable thickneſs, and that in this gulph the fires of the volcano ſtill continued active, of which the ſubterraneous noiſe, the fumes, vapours, and extreme heat were evident indications.

Another proof, in confirmation of this, is furniſhed by an obſervation I made at other times by night, for I was not contented with a ſingle viſit. This is, that, when it was dark, ſeveral blueiſh flames might be ſeen to riſe from the bottom, to the height of half a foot, a foot, and ſometimes higher. It is to be remarked, that thoſe which aſcended from the eminence before mentioned, were more numerous

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and roſe higher; and that beſides thoſe which iſſued ſpontaneouſly, it was in my power to produce new ones, by making ſmall excavations in the ground. The ſtrong diſguſting ſulphureous odour which all theſe flames emitted convinced me, that they were the effect of the ſulphur itſelf, which ſtill continued ſlowly to burn below, in a ſtate of fuſion.

But the object moſt curious and moſt intereſting to a naturaliſt is a grotto, on the weſt ſide of this bottom, which, from the variety of things it contains, merits to be deſcribed at ſome length. It is an excavation in the ſides of the crater a hundred and ten feet in height, two hundred and fifty in breadth, and ends at the bottom in a pit thirty feet in circumference. From this pit continually ariſes a column of whitiſh ſmoke, which alone equals in quantity, or perhaps exceeds, all the fumes that ariſe from the bottom of the crater. Its ſtrong and ſuffocating ſulphureous ſtench, and its extreme heat, prevent any near approach.

proach. A part of this ſmoke, meeting with no obſtacle, aſcends in a direct line, and riſes above the mouth of the crater; but another part of it, ſoon after it has iſſued from the bottom, is obſtructed by ſome ſtones which jut out from the ſides of the grotto; and attaching to the lower ſurface of theſe, the ſulphur which had been ſublimed with the ſmoke falls down again, and collecting, in ſeveral places, forms ſtalactites of ſulphur; ſome in the ſhape of inverted cones, and others cylindrical. The largeſt are three feet in length and two inches thick. On ſtriking ſeveral of them with a ſtick, I found that this ſulphur is extremely pure. Sometimes it is of a fleſh colour, but more frequently of a fine yellow; brilliant on the ſurface, and ſemi-tranſparent where the ſtalactites are thinner; which properties alſo give value to the other ſulphur that is dug round the crater of Vulcano, and exiſts likewiſe at its bottom; as I obſerved that, in the fiſſures from which the ſulphureous fumes iſſue, it is found conſolidated in fragments of various ſizes.

ſizes. The ſtalactical alone, however, has the cylindrical or conical form, which is produced by the fuſion of its parts, and their deſcent by gravity; whereas that which is generated under ground is uſually found in amorphous maſſes, and ſometimes in ſtrangely irregular configurations.

It ſeems ſcarcely neceſſary that I ſhould mention the manner in which ſulphur muſt be continually formed in this iſland; ſince it is well known that this mineral is not intirely conſumed in conflagration, but that a great part of it is ſublimed, unchanged in its ſubſtance, which again depoſits itſelf, ſometimes cryſtallized, and ſometimes amorphous, on any bodies with which it may meet. As it is therefore perpetually burning in the ſubterraneous furnace of Vulcano, it continually produces thoſe numerous white fumes which ariſe from various places, and theſe lumps, cylinders, and cones of ſulphur which I have before mentioned. The ſulphur which is ſo frequently found

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in other burning mountains is generated in the ſame manner.

From the pit within the cavern, whence the cloud of ſmoke continually iſſued, a louder noiſe was heard, than at any other part of the bottom; and on throwing ſtones into it, I could not perceive that they ſtruck againſt any obſtacle, as they gave no ſound, but a kind of hiſſing one occaſioned by the reſiſtance of the air in their fall. It appears probable, that this cavern has an immediate communication with the ſubjacent furnace of the volcano.

From one of the ſides of the cavern, at the height of eight feet from the bottom on which I ſtood, iſſues a ſmall ſpring of mineral water, which leaves on the different lavas depoſitions which well merit to be examined. If we ſuppoſe this water to proceed from the ſea, it can only be by evaporation, as the level of the ſea is very much lower than the place whence it iſſues. It

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may poſſibly derive its origin from rains, which penetrating to the interior parts of the mountain, and accumulating in ſome cavity, have here found a free outlet, depoſiting in different places the heterogeneous ſubſtances with which they became impregnated in their paſſage.

Where this water flows, we find, in the firſt place, hanging ſtalactites of ſulphate of alumine, ſome of which are of the thickneſs of ten inches, and a foot and a half in length. On breaking them, they are found to be a congeries of barks, or rinds, ſimilar to the coats of onions, as ſtalactites in fact uſually are.

Secondly, theſe ſtalactites are not always compoſed entirely of ſulphate of alumine, but are mixed with muriate of ammoniac.

Thirdly, the ſulphate of alumine, in ſome places, inſtead of being ſtalactical, is cryſtallized in beautiful ſtellated groups conſiſting of very fine ſilver ſilky threads.

Fourthly,

Fourthly, between the ſtones where this water iſſues, we frequently find ſtalactites of ſulphate of iron.

Laſtly, on the ground where this water falls, we find a number of hollows filled with a kind of thick pulpy matter, which is no other than a confuſed mixture of all theſe ſalts, which, from the partial evaporation of the water, begin to aſſume a body and conſiſtence.

To enable the reader to form a more diſtinct idea of the crater of Vulcano, of which I have deſcribed the principal objects, I have given a repreſentation of it in Plate V. in which the letters A, B, C, D, mark the upper oval circumference; F F, G G, the inclined ſides, to the ſouth-eaſt, by which I deſcended to the bottom of the crater; H H, a part of that bottom from which ariſe a quantity of fumes, and where I am repreſented ſtanding; I L, other fumes met with before we reach the crater; M, N, O, P, the extenſive ſandy plain which, to

the

the ſouth of the iſland, lies under the truncated cone on the top of which is the crater; Q, R, S, another ſmaller crater, of which I ſhall ſpeak in the following chapter.

The ſides of the crater of Vulcano, and the oval plain which forms its bottom, are covered with ſand, as has been already obſerved. This ſand, however, cannot properly be ſo called, ſince it is a mixture of fragments and ſmall particles of pumices, lavas, and glaſs, among which are found, principally where the ſulphureous fumes are ſtrongeſt, entire and large pieces of vitrifactions, pumices, and lavas, which well deſerve the careful and accurate examination of the obſerving naturaliſt.

We will begin with the former of theſe ſubſtances. At the bottom of the crater of Vulcano we find a glaſs which is of a lead-colour, and not unlike another kind found in aſcending the cone of Vulcano. Many pieces which lie without the fumes are preſerved unchanged; but many of thoſe within

in them exhibit different degrees of alteration. The firſt and ſlighteſt degree is a thin cinereous coating, which inveſts the glaſs, and is leſs hard than the internal part. The ſulphureous acids, therefore, have only acted on the ſurface of theſe pieces. In others they have penetrated deeper, as appears by the greater thickneſs of this tender and half pulverous coating. Some are ſo changed, that nothing remains of the glaſs but a ſmall central nucleus; while others have entirely loſt even this nucleus, and the whole piece, from being of a lead-colour, hard, ſemi-tranſparent, and ſmooth, is become of an aſh colour, ſoft, opake, and yielding to the touch. In theſe, therefore, the glaſs has undergone a complete decompoſition.

It had been diſcovered, long before I wrote on the ſubject of volcanos, that ſulphureous acids would decompoſe lavas; but I believe I am the firſt who has obſerved a ſimilar decompoſition in volcanic glaſs.

In

In the ſame place we find pieces, of various ſizes, of a more perfect, harder, and extremely black glaſs; which, likewiſe, where the ſulphureous acids abound, has undergone the ſame changes.

A number of particles of ſulphur are frequently attached to the ſurface of both theſe glaſſes, and ſome are alſo found within their ſubſtance, where ſmall fiſſures have opened to them an entrance.

We will now ſay a word of the pumices. They do not differ from thoſe we meet with on the declivity which leads to the ſummit of the mountain, and which, we obſerved, with an intenſe heat, changed into glaſs. Yet theſe likewiſe ſuffered more or leſs alteration from the above-mentioned acids. In ſome their fibrous texture was reduced to a kind of pulverulent earth, which ſcarcely retained a ſingle original filament. In others this texture was preſerved, yet they might be eaſily reduced to powder by the finger.

It now remains to treat briefly of certain priſmatic or baſaltiform lavas, likewiſe found in this volcanic bottom. In the firſt place, where the ſulphureous acids are ſtrongeſt, we find ſcattered pieces, ſuperficially decompoſed, which ſeem to have been broken off from larger columns. They have a pentagonal priſmatic figure, with unequal ſides and angles; and the larger pieces are about nine inches in length by eight in thickneſs. Their baſe is a petroſilex, which, from its having ſuffered fuſion, is of a very ſingular kind.

In the courſe of this work I have frequently had occaſion to ſpeak of lavas with a petroſiliceous baſe, and ſhall certainly have occaſion to ſpeak of them again. They are all too ſtrongly characterized for their baſe to be confounded with other ſtones. They, however, carry in them the marks of fire, in a certain fibrous appearance which they have, and which originates from a diminution of the affinity of aggregation when in a ſtate of fluidity. The petroſilex of which I

now

now ſpeak, on the contrary, exhibits no ſigns of injury from the fire, though it is certain that it has ſuffered fuſion. It is of that kind which is ſomewhat ſcaly; has a grain and hardneſs little different from that of ſilex; is tranſparent at the edges, of a ſhelly fracture, and of a livid aſh-colour. When pulverized it becomes white. The pieces, when ſtruck together, ſound like flint. This ſtone contains a few irregular ſhoerls, of a black colour, and but little luſtre.

After a continuance of forty-eight hours in a furnace of ſufficient heat to liquefy the fine cryſtal glaſs, this priſmatic lava with difficulty melts. To obtain a complete fuſion, it is neceſſary to have recourſe to a ſtronger heat; with which view I uſed a wind-furnace. After thirteen minutes, its volume increaſed almoſt threefold, from the diminiſhed force of aggregation; and then the lava acquired a ſnowy whiteneſs. Continuing the ſame fire, its dimenſions contracted, and it at length produced a white

enamel, moderately hard, and interſperſed with microſcopic bubbles.

The firſt time I ventured to explore the bottom of the crater of Vulcano, I only found ſome fragments of this priſmatic lava: but when I repeated my viſits, and had diveſted myſelf of the fear I at firſt felt, and more carefully examined this dreary bottom, I was enabled to complete my diſcovery by aſcertaining the origin of theſe priſmatic, or, as ſome may chooſe to call them, theſe baſaltiform lavas. For, raiſing my eyes to that part of the ſides of the crater which was over my head, and facing the north-eaſt, I perceived a large ſtratum of lava, almoſt perpendicular, divided length-wiſe into complete priſms, ſome of which were continued with the lava and made one body with it; while others were in a great meaſure detached from it, ſo that, ſtriking them with a long and heavy pole, I beat three of them down. I then clearly perceived that the pieces I mentioned above were fragments of entire priſms, ſince the external

external characters of both were preciſely the ſame.

Each of theſe priſms exceeded a foot in length; but, as far as could be judged by the eye, other priſms adhering to the maſs, which I could not reach, were of much larger dimenſions. The lava which contained them ſtretched to the ground, but did not appear of great extent, as its upper parts and ſides were covered with a thick ſand.

The production of theſe baſaltiform lavas, which, from their ſituation, and their forming a whole with the lava, no one can doubt derive their origin from fire, may, I conceive, be thus explained. In former times an effervescence took place in the melted lava in the crater, which, after having ſwelled, and perhaps overflowed its edges, ſlowly ſunk in the cavity of the crater, from the diminution of the fire, and the impellent elaſtic ſubſtances, while a portion of the lava attaching itſelf to the internal ſides, and haſtily cooled by the atmoſpheric air,

 contracted,

contracted, and divided into regular parts, ſuch as are the forms of the hexagon priſms above mentioned. Their perfect preſervation and freſhneſs are a clear proof that they are not of very ancient date.

I ſhall conclude this chapter with a few obſervations relative to the decompoſitions which I remarked in various productions both within and around the crater of Vulcano. Theſe decompoſitions I have ſaid were produced by ſulphureous acid exhalations. I have aſſerted the ſame of ſome decompoſed lavas in the vicinity of the volcano of Stromboli, as alſo of a great number of thoſe of which Solfatara is principally formed *. And in general, when the queſtion is of lavas, the alteration of which conſiſts in being ſoftened and rendered mild and ſaponaceous like argilla, and in a whitening of the parts, I perceive that the greater number of volcaniſts agree with me in ſentiment. I find, however, that M. Sage is of a different opinion, maintaining that ſuch

* See Chap. II. and Chap. XI.

decom-

decompoſitions are generally to be aſcribed to the action of the muriatic acid, which is the cauſe of the greater part of the alterations that take place in the products of volcanic eruptions. He attempts to demonſtrate this by the experiment of a black lava which, in his laboratory, became white and equally decompoſed with thoſe found in ſome volcanos, by keeping it in digeſtion in concentrated muriatic acid. Other ſimilar experiments likewiſe confirm him in this opinion *.

That the muriatic acid is capable of producing decompoſitions in various volcanic productions analogous to thoſe we frequently obſerve in the materials of burning mountains, I am the more eaſily perſuaded, ſince, having repeated the experiment of the French chemiſt, I have found it accurate. I placed in two veſſels, filled with concentrated muriatic acid, ſome fragments of two different lavas, the one from Etna, the other from Veſuvius, both of a colour approaching

* Elemens de Mineralogie.

black, of the horn ſtone baſe, and containing a number of black ſhoerls. Having cloſely ſtopped the veſſels, I left them for a month; at the end of which time the lavas were become of a yellowiſh cinereous colour; and, having waſhed away the muriatic acid with which they were impregnated with diſtilled water, they loſt the yellowiſh tincture, and became entirely of the cinereous colour. Some of them had likewiſe become in ſome degree friable, though before they were hard. The decompoſition had in fact penetrated more or leſs to their internal parts, though the ſhoerls remained unaltered both in texture and colour.

This author however admits, in another place, that the ſulphuric acid is likewiſe capable of producing the ſame effect, which I alſo experimentally aſcertained on the two lavas above mentioned *. It is, in like

* Notwithſtanding that, at the end of a month, the muriatic and ſulphuric acids had been equally effica-

like manner, known, that the ſulphuric acid poſſeſſes an equal ſtrength when the ſulphur is cauſed to burn very ſlowly. It remains, therefore to determine which of theſe two acids, the muriatic or the ſulphuric, is the real cauſe of the decompoſition and whitening which is frequently obſerved in products of volcanos, at leaſt of thoſe which I have moſt attentively examined, Stromboli and Vulcano. And though

cious in producing alteration in the two lavas, yet, after a longer time, the muriatic appeared to be more powerful than the ſulphuric. At the end of ſeven months and a half, on examining the lavas which had remained in the ſame ſituation in the two acids, I found that the muriatic acid had decompoſed them more than the ſulphuric. Beſides that they had acquired a whiteneſs almoſt equal to that of ſnow, they had become very light, and extremely friable and ſpungy, from the corroſion of the acids. The ſhoerls remained black, but had loſt their vitreous appearance. Both theſe lavas, likewiſe, contained a number of feltſpars, which ſuffered leſs than the ſhoerls, as they always retained their natural changing luſtre. But the ſulphuric acid only produced in theſe lavas a cinereous colour, a leſs degree of friability and lightneſs than was cauſed by the other acid; and the black ſhoerls did

though I ſhall, in another part of the preſent work, produce direct proofs, that ſome lavas, enamels, and volcanic glaſſes, ſometimes give reception to the muriatic acid, yet, certainly, the decompoſitions in queſtion are not to be attributed to this acid, but to the ſulphureous. The odour of theſe acids is too different for them to be confounded; and both at Stromboli and Vulcano, in the places where theſe decompoſed products are found enveloped in

did not loſe any of their glaſſy brilliancy. This acid was concentrated equally with the muriatic. Inſtead of the colour and limpidneſs of water, it was become turbid and dark. The muriatic had acquired a beautiful golden yellow. I muſt add, that having poured ſome freſh ſulphuric acid on the old, the decompoſition and whitening of the lavas, after ſome time, was not inferior to that produced by the muriatic acid. I found a remarkable difference between the alteration obſervable in lavas in the vicinity of volcanos, and that which is effected by the ſulphuric and muriatic acids, ſince the volcanic alterations are ſometimes accompanied by an unctuous ſmoothneſs I never obſerved in the two lavas expoſed to the action of the above-mentioned acids, which on the contrary had become rough and ſcabrous.

white

white fumes, I very ſenſibly perceived the acrid, pungent, and ſuffocating fetor of the ſulphur, as alſo the ſharp taſte, if a particle of the fumes, by accident, entered my mouth. I likewiſe particularly remarked, at Vulcano, that where the ſulphureous fumes were moſt denſe, and left cruſts of ſulphur attached to the bodies they touched, theſe bodies, whether lavas, pumices, or glaſſes, ſuffered greater alteration than others; and, in ſome of them, the decompoſition had penetrated to the depth of two feet.

An experiment which I ſhall now relate offers a new and indiſputable proof of what I have here aſſerted. At Vulcano, I left a piece of extremely black lava, which had for its baſe ſhoerl in the maſs, and was one of the firmeſt and hardeſt I could find, in an aperture from which iſſued a great quantity of very hot fumes; and, after it had continued there two-and-thirty days, I obſerved, that, in its upper part, it remained untouched; its black colour, only, having become

become ſomewhat lighter; but on the ſides, and ſtill more on the lower part, where the impreſſion made by the ſulphureous fumes had been greater and more active, it was become white, with a ſenſible ſoftening of the ſolid parts near the ſurface.

Had M. Sage, inſtead of deciding, while ſhut up in his laboratory, that the muriatic acid is the cauſe of the alterations which take place in volcanic countries, himſelf viſited thoſe countries, he would have thought differently; and had he in the courſe of ſuch a journey entered the Grotta del Cane near Pozzuolo, the expreſſion would never have eſcaped him, that *this perpetual mephitis is produced by the volatile marine acid* *.

See Chap. III.

CHAP. XIV.

VULCANO CONTINUED.

Among the few naturaliſts who have made a voyage to the Eolian iſles, M. de Luc the only one who has entered the crater of Vulcano—Summary of the obſervations made by him there, in 1757, *compared with thoſe of the Author—Similarities and differences between the local circumſtances of the crater at that time and thoſe of the preſent crater—Obſervations made by the Commendator Dolomieu from the ſummit of the crater in* 1781—*Remarkable changes which have, ſince that time, taken place in the crater—Commotion of Vulcano in* 1786—*No eruption of lava from the crater has happened within the memory of any of the natives of Lipari now living—The phænomena of this volcano habitually obſerved by them—Viſits made to this crater by Father Bartoli, in* 1646, *and Profeſſor*

feſſor d'Orville in 1727—*Interior conflagration through the whole of the crater at the firſt period*—*Not one but two craters at the ſecond*—*Hill which at that time roſe from the bottom of one of the two craters*—*Vulcano then in its greateſt agitation*—*Some obſcure memory ſtill retained by ſome aged natives of Lipari of a double crater at the ſummit of Vulcano*—*Sterility of this iſland on the ſide next Lipari, though there is no want of vegetation on the oppoſite ſide*—*Porphyritic lavas in this part of the iſland, but greatly decompoſed*—*Small crater on the ſide of Vulcano deſcribed for the firſt time*—*The fumes of Vulcano obſerved by ſome of the Liparese as ſigns of good or bad weather, in the ſame manner as the inhabitants of Stromboli conſult their burning mountain*—*Obſervations publiſhed by a native of Lipari, on the diverſity of the fumes, and internal commotions of Vulcano, betokening, according to him, what winds will blow*—*Obſervations of the Author not agreeable to thoſe of the Liparese*—*The fires of Vulcano*

more

more powerful at that time than now, if the accounts given by that writer may be relied on—Ancient accounts of the conflagrations of Vulcano—Number and ſize of its craters —Its different eructations—This burning mountain, in a certain degree, comparable to Veſuvius and Etna—Prognoſtics of the winds which may be expected to blow from the ſymptoms of the volcano very ancient; and perhaps deſerve equal credit with the modern.

AMONG the very few naturaliſts who have made a voyage to the iſlands of Lipari, M. W. de Luc is the only one, to my knowledge, who has entered the crater of Vulcano. This he did on the 30th of March, 1757, as appears from an account of the obſervations he made there, puliſhed in the ſecond volume of the Travels of M. de Luc, a ſummary of which account I ſhall here preſent to the reader, as we ſhall thus be enabled to compare the local circumſtances which exiſted at that time, with

with thoſe obſerved by me in one of the moſt ſuperb and ſpacious gulphs at this day to be found among burning mountains.

He relates that he reached the bottom of the crater, by a narrow paſſage, which afforded him entrance, but with great riſk of being ſuffocated by the denſe ſulphureous fumes that enveloped him; in conſequence of which danger he was obliged to enter alone, the guide who had conducted him to the ſummit of the crater, and who was a native of Lipari, having refuſed to follow him. He found the bottom very rugged and uneven, of an oval form, with ſeveral apertures, from which iſſued ſulphureous vapours, and from ſome a ſtrong wind. The ſound of his feet as he walked on it was very ſenſible.

The longeſt diameter of the oval appeared to him to be about eight or nine hundred paces, and the ſhorter between five and ſix hundred. The height of the

ſides

ſides of the crater he imagined might be about one hundred and fifty, or, towards the eaſt and the ſouth, two hundred feet. At the bottom they were nearly perpendicular, and were compoſed entirely of volcanic materials.

A column of ſmoke, of fifteen or eighteen feet in diameter, iſſued from a cavern which above loſt itſelf in one of the higheſt ſides of the crater, and below ended in a kind of tunnel, or rather abyſs, of about ſixty paces in circuit; and the fumes on iſſuing out of that abyſs roared like the vapour of boiling water, when it eſcapes from a veſſel not cloſely covered. Several pieces of ſcoriæ being thrown into it were no longer heard when they had paſſed beyond the tunnel.

Another object likewiſe ſtrongly attracted the attention of M. de Luc: this was an aperture, five or ſix inches in diameter, which terminated in a ſmall tunnel about two feet and a half deep, from which the air

 ruſhed

ruſhed with as much violence as from the bellows of a forge. He threw into it great pieces of lava, which enlarging the opening, cauſed the wind to iſſue with leſs force, but the ſmall pieces that were detached from the aperture were driven outwards by it. The fragments of lava which fell within, produced the ſame effect as the ſcoriæ thrown into the tunnel of the cavern. As theſe obſervations convinced him of the extreme thinneſs of the floor or ſhell on which he ſtood, he thought it adviſable to quit this perilous gulph, and direct his reſearches to objects leſs dangerous.

He then remarked that the ſulphureous vapours of the volcano had here a communication with the ſea, which was in many places of a yellow colour, and in others emitted fumes; and that in the places where the fumes roſe its heat was intolerable; ſo that the fiſh that happened to approach that ſhore ſoon died, and the beach, where a few inches above the level of the ſea warm veins of

water burſt out, was ſcattered over with dead fiſh.

Such is the ſubſtance of the obſervations of M. de Luc, made about thirty-one years before mine. On comparing the one with the other, it will appear, that if the internal parts of the crater of Vulcano have ſuffered ſome changes ſince that time, they are ſtill eſſentially the ſame. At preſent (at leaſt, at the time when I was there, I might have ſaid, at preſent) the ſides of the crater are in moſt parts nearly perpendicular, the circumference of the bottom is an oval, from a number of fiſſures and apertures ſulphureous fumes iſſue, and from others ſtreams of wind with a hiſſing ſound. The bottom likewiſe ſhews evidently that it is a dangerous and a falſe bottom, by ſhaking and ſounding when walked over. The cavern excavated in the ſides of the crater, and deſcribed by the above-cited traveller, alſo ſtill exiſts, and from it a cloud of ſulphureous fumes continues to exhale; and had not M. de Luc been fearful of proſecuting his reſearches, it

is more than probable that he would have found it abounding with ſulphur and various ſalts, as it is at preſent.

The differences, therefore, between the ſtate of the crater at the time it was entered by M. de Luc and at preſent, are reduced to theſe; firſt, that the narrow paſſage by which he reached the bottom now no longer exiſts; but that, on the other hand, the ſides on the ſouth-eaſt are become leſs ſteep, and afford a way to deſcend into that gulph: ſecondly, that the height of the crater is now much greater than it was then, as I found it to exceed a quarter of a mile, whereas when M. de Luc was there it was not more than two hundred feet: laſtly, that the furnace below the bottom burns much more violently at preſent, as may be inferred from the intenſe and almoſt intolerable heat I felt when I was there, which circumſtance, had it exiſted when M. de Luc made his obſervations, he certainly would not have failed to have mentioned.

I do

I do not mean to ſay by this that the ſubterranean conflagration of the iſland is now more active or energetic; ſince it appears that the extreme heat, though not then felt within the crater, manifeſted itſelf without, and even in the ſea itſelf, which, as has been obſerved, ſmoked in ſeveral places near the ſhore, and was ſo hot that the fiſh all died; circumſtances which did not exiſt when I viſited the iſland.

M. Dolomieu, who was there ſeven years before me, could not go down into the crater, becauſe the narrow paſſage by which M. de Luc entered no longer exiſted, and the ſides were too ſteep to admit of any deſcent. The volcanic mouth, however, was then in the ſame ſituation, was large, of an oval form, and emitted, in a great number of places, ſulphureous-acid and ſuffocating fumes.

Yet within this ſhort interval, very conſiderable changes have taken place. The depth of the crater, as far as a judgement

could be formed by the eye, was then about a mile, the larger diameter of its mouth was half a mile, and that of its bottom about fifty paces. Whence it appears that the bottom, since that time, must have been greatly raised, and likewise have become narrower; while the mouth has been considerably enlarged. From the edge of the crater, he threw into it large stones, which, when they reached the bottom, he perceived sank in some fluid, that could not be aqueous, since it must have been soon evaporated by the excessive heat, but which he judged to be melted sulphur; as he in fact saw that substance trickle down the sides against which it had sublimed. With a good telescope he could discover at the bottom two small pools, which he supposed to be full of the same combustible matter. He likewise observed that the sulphurous fumes which in the day time appeared white, were by night resplendent but placid flames, that rose above the mountain, and diffused their light to some distance.

When

When I made my obſervations at the bottom of the crater, though the ſulphur flowed in many parts of the cavern, as I have already ſaid, yet it did not ſtagnate in ſmall pools or pits at the bottom; nor did the ſulphureous flames ariſe by night more than ſome feet from the bottom.

The changes which have taken place in the internal parts of this volcano, ſince it was viſited by the French naturaliſt, have probably originated from ſome later eruption; ſince it is to that cauſe that changes of any moment in volcanic craters are uſually to be attributed. And in fact, according to the unanimous teſtimony of the inhabitants of Lipari, it ſuffered a very violent commotion in the month of March 1786. After ſubterraneous thunders and roarings, which were heard over all the iſlands, and which in Vulcano were accompanied with frequent concuſſions and violent ſhocks, the crater threw out a prodigious quantity of ſand mixed with immenſe volumes of ſmoke and fire. This eruption

continued fifteen days; and ſo great was the quantity of ſand ejected, that the circumjacent places were entirely covered with it to a conſiderable height; and, at a ſmall diſtance from the crater, to the eaſt, there is ſtill an eminence, of a conical form, half a mile in circumference, conſiſting wholly of this pulveriſed ſubſtance, and, as I was aſſured, entirely produced at this time. The aperture that muſt then have been made in the bottom of the crater to diſcharge ſuch a quantity of matter, and the accumulations of that matter in various places, muſt neceſſarily have cauſed great changes around and within the crater; one of which, without doubt, is the declivity produced in the ſouthern ſides, in conſequence of which it is now poſſible to deſcend to the bottom of the gulph; for we find that this long deſcent is entirely compoſed of ſand.

No lava flowed in this eruption, at leaſt not over the edges of the crater. With reſpect to the lava of a vitreous nature which is found on the ſurface on the north-

ern ſide of the mountain, and of which we have already ſpoken, M. Dolomieu obſerved that it exiſted when he was there, and he tells us that it was thrown out, in large maſſes, in an eruption in the year 1775: an aſſertion of the truth of which he ſhould have produced unqueſtionable documents; for, according to the accounts I received from the natives of Lipari, no eruption of lava has happened in the memory of any perſons now living in the iſland, nor do they ſeem to have a tradition of any. Clouds more or leſs frequent or thick, ſometimes black and ſometimes of a white colour, and emitting a ſtench of ſulphur; ſubterraneous thunders and concuſſions, which often ſhake the whole mountain; flames which riſe to a greater or leſs height from the bottom and ſides of the volcanic gulph; the poſſibility of entering this gulph at one time, and the impoſſibility of ſuch entrance at another; ejections, at different times, of ignited ſtones, pieces of vitreous ſubſtances, ſand, and aſhes; theſe are phe-

nomena

nomena with which the people of Lipari have been long acquainted.

I muſt here add the obſervations of two other men of ſcience, relative to the crater of Vulcano; Father Bartoli, and M. d'Orville. The former viſited the iſland in 1646, and relates that it contained a deep gulph, entirely in a ſtate of conflagration within, and, in a ſmall degree, to be compared to Etna; and that from its mouth a copious ſmoke continually exhaled *.

When M. d'Orville viſited Vulcano, in 1727, it had two diſtinct craters, each of which was at the ſummit of an eminence. From the firſt crater, which was ſituated to the ſouth, and which was about a mile and a half in circuit, beſides flame and ſmoke, ignited ſtones were ejected; and its roaring was not leſs than that of the loudeſt thunder. From the bottom of this gulph roſe

* Simboli traſportati al Morale.

a ſmall

a ſmall hill, about two hundred feet lower than the top of the crater, and from this hill, which was entirely covered with ſulphur and dirty corroded ſtones, fiery vapours exhaled in every part. M. d'Orville had, however, ſcarcely reached the edge of this burning furnace when he was obliged precipitately to retire.

The ſecond crater lay towards the north part of the iſland. Its conflagrations were more frequent and ardent; and its ejections of ſtones mixed with aſhes and an extremely black ſmoke were almoſt continual. M. d'Orville further relates that the noiſe of this volcanic iſland was heard many miles; and was ſo loud at Lipari that he could not ſleep the whole night that he remained there *.

If we conſider, for a moment, theſe two accounts, we ſhall perceive, from the firſt, that when Father Bartoli viſited Vulcano,

* Jacobi Philippi d'Orville Sicula.

the

the conflagration in its crater was much more vigorous than when I was there; and from the ſecond, that in the time of D'Orville it was in a ſtate of complete eruption. But the moſt remarkable circumſtances are the double burning crater, and the bifurcation of the mountain of Vulcano; whereas, at preſent, there is but one crater, and the ſummit of the mountain is ſingle, which ſummit contains the crater, reſembling in figure a truncated cone. The hill which roſe to a certain height from the bottom of one of the two craters, ſtill exiſts, though it is not peculiar to this volcanic mouth, ſince the ſame kind of hill has at times been obſerved in Etna *, and likewiſe in Veſuvius †.

* When I was at Lipari, as I had read D'Orville's account, I made enquiries of ſome of the oldeſt people in the iſland relative to this double burning crater, and I found ſome few of them who retained an imperfect recollection of it. But from that

* See Chap. VIII. † Bottis, Iſtoria di Veſuvio.

time

time to this there has been only one crater, and I am not certain whether the preſent be that which the above-cited author deſcribes as on the ſouth ſide of the iſland, or that which he mentions as on the north.

The ſide of the iſland which looks towards Lipari is entirely barren, and does not produce any kind of vegetable; but this is not the caſe with the other ſides that front the ſouth and the weſt, and which are partly covered with holms and oaks, beſides quantities of broom and other ſhrubs. It is obvious to ſuppoſe that thoſe parts of the iſland which afford ſo much nouriſhment for plants have been more ſubject to decompoſitions than that which remains barren. The ſubſtances of which they are compoſed, are lavas become ſoft to a certain depth, and affording reception and nutriment to plants. This decompoſition is not to be attributed to ſulphureous acids; for it is not diſtinguiſhed by a white or any other colour; but originates from the humid elements, and other cauſes in the atmoſphere.

ſphere. I cauſed ſeveral of theſe lavas to be broken away with hammers and pickaxes, quite to the internal part, to which the cauſes producing change could not penetrate; and there I found them retain all their uſual ſolidity and freſhneſs. In general they are porphyritic, with a petroſiliceous baſe, and contain feltſpathoſe cryſtallizations. They deſcend from the ſummit of the mountain, on the ſouthern ſide, with a ſteep fall till they reach the ſea. Mixed with the lavas are found large pieces of glaſs and enamel, which I ſhall not here deſcribe, as they do not differ from thoſe of Lipari, of which I ſhall ſpeak in their place.

Such are the obſervations I made in four different viſits to this iſland, to which I ſhall add another relative to a ſmaller crater, different from that of Vulcanello, and which has not, to my knowledge, been noticed by any other traveller. It lies about half way up the mountain, to the eaſt of the way I took to reach the ſummit. Its form could

not more distinctly characterize it as a real crater, since it is precisely that of a tunnel, wide above and narrowing below. Its mouth is about three hundred feet in circuit, and its bottom about eighty. A full quarter of this bottom is filled up with earth carried by the rain down the sides, which are in consequence marked with long furrows. Hence it appears, that, in process of time, this crater will be entirely filled up with earth, like that of Vulcanello, and no trace of it remain (See Plate V. Q. R. S.).

In the same manner as many of the sailors of Stromboli, before they put to sea, are accustomed to consult the fumes and eruptions of their burning mountain; the mariners of Lipari believe the changes of the winds and weather may be foretold by observing Vulcano. Instructed, they say, by long experience, they are able to predict, twenty-four hours before any change, whether the weather will be fair or tempestuous, and from what point the wind will blow. In a work entitled *Tracts by*

Sicilian

Sicilian Authors *, printed at Palermo in 1761, there is a *Phyſico-mathematical Diſcourſe on the manner in which the variations of the winds may be foretold, twenty-four hours before they happen, by the different qualities and effects of the fumes of Vulcano*, by Signor Don Salvadore Paparcuri of Meſſina †. In this eſſay we find an extract from a number of obſervations made on Vulcano between the years 1730 and 1740, and communicated to the author by Don Ignazio Roſſi, a native of Lipari. This extract I ſhall here preſent to my readers.

" The change of weather and winds is " preſignified by Mount Vulcano twenty- " four hours before it takes place, by a " louder than uſual noiſe, reſembling diſ- " tant thunder; and if we carefully obſerve " the ſmoke which then iſſues in a greater

* Opuſcoli di Autori Siciliani.

† Diſcorſo Fiſico-matematico ſopra la variazione de' venti pronoſticata ventiquattre ore prima dalle varie e diverſe qualità ed effetti de' fumi di Vulcano, del Sig. Don Salvadore Paparcuri, Meſſineſe.

" quantity

" quantity than uſual, we may likewiſe diſ-
" cover what kind of wind will ſucceed,
" which may be predicted from the greater
" or leſs denſity of the ſmoke, and its more
" or leſs dark colour, which is occaſioned
" by the quality and quantity of the duſt
" that riſes in the ſmoke, and renders it
" ſometimes of an aſh-grey colour, ſome-
" times perfectly white, ſometimes of a co-
" lour approaching to black, and ſometimes
" entirely black.

" The following are the obſervations I
" have made on this ſubject. When the
" wind is about to change to the ſirocco
" or ſouth-eaſt, or the eaſt-ſouth-eaſt, or
" ſouth-ſouth-eaſt, the ſmoke riſes ſo denſe
" and black, in ſo great a quantity and to
" ſuch a height, and afterwards diſſipates in
" ſo black a duſt as to ſtrike the beholder
" with a kind of awe; and at the ſame time
" ſo loud a roaring is heard, frequently ac-
" companied with a ſhaking of the earth, as
" to inſpire with dread even thoſe long ac-
" cuſtomed to theſe roarings and ſhocks. But

" when the wind is on the point of chan-
" ging to the north-north-eaſt or north-
" north-weſt, the ſmoke riſes more ſlowly,
" is leſs denſe, and entirely white; and when
" it is diſſipated, the duſt which falls is ex-
" tremely white. No ſuch loud noiſe is
" then heard, nor any ſhock felt; at leaſt I
" obſerved none, nor can the oldeſt inhabit-
" ants of this iſland remember to have felt
" any. When it is about to change to the
" eaſt or eaſt-north-eaſt, an exploſion is
" heard in the body of the mountain, which
" ſoon after throws out a little ſmoke of
" a grey colour, of which colour are likewiſe
" the aſhes that fall when the cloud is diſ-
" perſed. The mountain in the mean
" time explodes and roars ſo violently at in-
" tervals, that we frequently dread the ſhock
" of an earthquake. Laſtly, previous to a
" change of the wind to the weſt, the weſt-
" ſouth-weſt, or weſt-north-weſt, vaſt vo-
" lumes of ſmoke ariſe, of a dark aſh-grey,
" approaching the colour of lead, and ſo
" thick that when they diſperſe they occa-
" ſion a continued ſhower of aſhes."

On

On theſe obſervations of the Lipareſe meteorologiſt, Signor Paparcuri proceeds to philoſophize, whether pertinently or not I ſhall not enquire.

I ſhould think myſelf juſtly to incur the imputation of raſhneſs, ſhould I venture abſolutely to deny theſe facts, without having ſufficient reaſons ſo to do; eſpecially as they are ſo preciſe, ſo circumſtantial, and ſaid to have been obſerved upon the ſpot. It, beſides, does not appear credible that the Abbate Roſſi would have publiſhed theſe obſervations, had they been merely the fabrications of his invention, in a place where he was liable to be diſgraced by the contradiction of all his countrymen. I muſt however ſay, with philoſophic candour, that during my ſtay of ſeveral weeks at Lipari, where I continually had Vulcano before my eyes, the principal winds mentioned in this extract blew, and particularly the ſouth-eaſt, the weſt, and the ſouth-weſt; but I never obſerved, either before they began, or while they continued to blow, any

ſhakings of the earth, or roarings, lofty columns of ſmoke, or ſhowers of aſhes. Once only, when a violent ſouth-weſt wind was on the decline, the column of ſmoke which iſſued from the cavern of Vulcano increaſed prodigiouſly, and, from the reſiſtance of the agitated atmoſpheric air, made ſome ſpiry windings; but when it had riſen ſome poles above the upper edge of the crater, it began to grow thinner, and ſoon after entirely vaniſhed. Though the wind ceaſed to blow, this prodigious cloud of ſmoke ſtill continued to riſe for ſeveral hours. I muſt add, that I once remarked the ſmoke of Vulcano to be extremely thin, and little in quantity, when a ſtrong weſt wind blew; and that twice, when the air was perfectly calm, I obſerved the ſmoke extremely copious and riſing to a great height. To conclude, after carefully noticing, day by day, every change that took place in the phenomena exhibited by Vulcano, during my ſtay in its vicinity, I could perceive none which afforded ſupport to theſe famous prognoſtics. I likewiſe enquired of the ſailors of Lipari, and

and frequently brought them to confeſs that the fact did not accord with their aſſertions. But, beſides that they did not agree among themſelves, they endeavoured to evade conviction by all thoſe excuſes and pretexts which I have obſerved ſea-faring people never to want, to ſupport their particular prejudices relative to the ſigns of good or bad weather; in conſequence of which, they ſometimes become the victims of their own credulity by ſuffering ſhipwreck.

I am not, however, ſo poſitive as to deny the whole of theſe obſervations. To know with certainty whether any direct relations exiſt between the various ſymptoms of Vulcano and the changes of the atmoſphere, it would be neceſſary to reſide for ſome years in that iſland, a place truly wild and deſolate; and he who, like Empedocles at Etna, ſhould go to erect his dwelling there, in order to obſerve the changes of the mountain, would have no other companions than the rabbits which make their burrows on the ſouthern ſide of the iſland.

Diſregarding, however, at preſent, the pretended relations, obſerved by Signor Roſſi, between Vulcano and the winds; if the accounts of the eruptions which then from time to time iſſued from its crater may be relied on, we muſt own that, at that period, the convulſions of this mountain were much more violent and frequent than they are at preſent: a fact which accords with the obſervations of M. d'Orville and Father Bartoli.

Before I conclude my remarks on Vulcano, two things remain for me to notice, agreeably to the plan I have followed relatively to the other Eolian iſles. Firſt, to ſpecify the reſults obtained by our common fires in thoſe kinds of rock which, liquefied by ſubterranean conflagrations, have given birth to the iſland; and, ſecondly, to mention the notices left us by the ancient writers relative to Vulcano. The former object of enquiry has been ſufficiently diſcuſſed, while treating of Stromboli, where we have detailed the changes undergone in the furnace

furnace by porphyritic rocks; ſince, as has been already ſhewn, rocks of a ſimilar kind have furniſhed the materials of which Vulcano is compoſed. We have therefore only to treat of the latter of theſe ſubjects.

We are indebted to Thucydides for the firſt account we have of this iſland. He relates in his hiſtory, that, in his time, Vulcano threw out a conſiderable flame by night, and ſmoke by day *.

Ariſtotle, in his Treatiſe concerning meteors, deſcribes an ancient eruption of Vulcano, a part of which ſwelled, and roſe, with great noiſe, into a hill; which burſting, a violent wind iſſued forth, together with fire, and ſo great a quantity of aſhes as entirely to cover the neighbouring city of Lipari, and extend to ſeveral of the towns of Italy. This eruption was ſtill viſible in his time †.

* Την νυκτα φαινεται πῦρ αναδιδȣσα (Ἱερα) πολυ, και την ἡμεραν καπνον.

† Εν Ἱερα εξανωδει τι τῆς γῆς, και ανηει οιον λοφωδης ογκος μετα ψοφȣ. τελος δε ῥαγεντος, εξηλθε πνευμα πολυ, και τον φεγγαλον, και την τεφραν ανηνεγκε, και τηνδε Λιπαραιων πολιν, ȣσαν ȣ πορρω πασαν κατετιφρωσε, και εις ενιας των εν Ιταλια πολεων ηλθε. Lib. II. cap 8.

The intereſting obſervations of Polybius, relative to the number, ſize, and figure of the craters of Vulcano, are likewiſe particularly deſerving our notice. In his time, there were three; two tolerably well preſerved, and one, in part, fallen in. The mouth of the larger, which was round, was about five ſtadia, or five-eighths of an Italian mile, in circuit. This crater, towards the bottom, grew gradually leſs, till, at laſt, it was only fifty feet in diameter; this part was one ſtadium above the level of the ſea. The form of the other two craters was the ſame*.

Such is the account of Polybius, as quoted by Strabo, who himſelf tells us of three openings, or craters, at Vulcano, from which flames iſſued and ignited matters were thrown out, that filled up a part of the ſea of conſiderable extent †.

From

* Πολυβιος δε των τριων κρατηρων τον μεν κατερρυηκεναι φησιν εκ μεγους, τας δε συμμενειν, τον δε μεγιστον το χειλος εχειν περιφερες ον, πεντε σταδιων· κατ' ολιγον δε συναγεσθαι εις η ποδων διαμετρον, καθ' ὃ βαθος ειναι το μεχρι θαλασσης σταδιαιον. Strab. lib. VI.

† Εχει δε αναπνοας τρεις, ως αν εκ τριων κρατηρων. εκ δε

From the two latter paſſages we learn, therefore, that, anciently, there were in Vulcano three burning mouths, or, more properly, craters; and that one of them was very large. Are we to conclude that this larger crater was the ſame that at preſent exiſts, and which, ſince that time, may have increaſed its dimenſions? This may poſſibly be the truth; and it may, perhaps, be equally ſo, that, of the three craters mentioned by Polybius and Strabo, two ſtill remained in the time of D'Orville, who found a double burning crater at Vulcano, though at preſent there is only one; the other two no longer appearing, either becauſe they have fallen in, or been filled with earth by the rains, or, poſſibly, have been covered by ſubſequent ejections.

From the text of Strabo it may be inferred, that, in his time, Vulcano ejected lava, ſince the burning matter thrown out

δε τȣ μεγιστȣ και μυδρȣς αι φλογες αναφερȣσιν, οι προσκεχωκασιν ηδη πολυ μερος τȣ πορȣ. Strab. Lib. VI.

filled

filled up a part of the ſea of conſiderable extent.

Callias, in his Life of Agathocles Tyrant of Syracuſe, relates, that on a lofty eminence of Vulcano there were two craters, one of which was, three ſtadia in circumference, caſting a great light to a vaſt diſtance; and that from this mouth burning ſtones, of a prodigious ſize, were thrown out with ſo great a noiſe that it might be heard to the diſtance of five hundred ſtadia *.

If, therefore, we believe the teſtimony of Diodorus and Fazello, who, as natives of Sicily, have the beſt claim to our attention, we have already ſeen, when treating of Stromboli, that the former aſſerts, that both

* Ιστορει Καλλιας, εν δεκατω των περι Αγαθοκλεα, λεγων ειναι και λοφον υψηλον, εφ' ᾧ κρατηρες εισι δυο, ων ὁ ἑτερος εστιν περιμετρον τρισταδιος, εξ ᾧ πολυ φερεται φεγγος, ωστε επι πολυν τοπον διηκειν φωτισμον. επειτα εκ τε χασματος αναφερονται διαπυροι λιθοι απλετομεγεθεις· και τηλικουτος βρομος γινεται, ωστε επι πεντακοσια σταδια ακουεσθαι τον ηχον. Scholiaſt. in Apollon. Argonaut. Lib. III.

that

that iſland and Vulcano threw out ſands and burning ſtones; and we learn from the latter, that Vulcano was in a continual ſtate of conflagration; and that from its gulph, which lay in the middle of the iſland, a cloud of thick ſmoke continually iſſued, while, through the fiſſures of the ſtones, and narrow apertures, a pale flame aroſe in the midſt of the dark cloud *.

Cluverius likewiſe affirms, that from the neighbouring ſhore of Sicily he had himſelf obſerved by night a ſimilar fire amid the dark ſmoke †.

And here it is proper, with Cluverius, to correct a miſtake of Fazello, who, relying

* Hæc (Vulcani Inſula) in medio mari aquis circumfuſa perpetuo ardet. Enimvero ex voragine, quæ in medio patet, jugiter ingentem fumi nebulam horrie eructat. Intus vero per juncturas lapidum, et cancellos, anguſtoſque meatus exurens, ſimul, et pallens ignis inter ipſam fumoſam caliginem emittitur. Hiſtor. Lib. I.

† Hujuſmodi inter fumoſam caliginem pallentem ignem egomet nocte e proximo littore Siculo deſpexi. Ubi ſup.

on

on the authority of ſome ſuperficial writer, has been induced to believe that the iſland of Vulcano emerged from the ſea in the year of Rome 550, without reflecting that, two hundred years before that period, it is mentioned by Thucydides, and that Ariſtotle, about a century after him, had deſcribed one of its eruptions. The miſtake has been occaſioned by the origin of Vulcanello, which about this time aroſe out of the water. Pliny has remarked that when this iſland was thrown up, a great number of fiſh were found dead, and cauſed the death of thoſe who ate of them.

The ſame Fazello relates, that Vulcano was ſeparated from Vulcanello by a narrow channel of the ſea, in which ſhips might lie with ſafety; and that this ſtrait was open in his time, but afterwards filled up by new eruptions of Vulcano *.

This brief ſtatement of facts recorded by hiſtory,

* Vulcanellus tenuiſſimo Euripo a Vulcania (Inſula) recedit

hiſtory, when compared with the obſervations of Bartoli, D'Orville, De Luc, Dolomieu, and myſelf, clearly proves that this iſland is a volcano which may be compared to Veſuvius or Etna, with reſpect to the changes in its craters, the variety of its eruptions, and its longer or ſhorter intervals of repoſe; except that, from the want of aliment for its fires, its ejections are leſs frequent and leſs copious.

From the authorities above adduced, we perceive that the fires of this mountain are very ancient, ſince they burned in the age when Thucydides flouriſhed, or 475 years before the Chriſtian æra. This iſland was then called *Hiera* (Ἱερα) or the *ſacred* iſle, as being ſacred to Vulcan; for the inhabitants of the neighbouring iſlands, as Thucydides informs us, perceiving it continually to flame by night, and ſmoke by day,

recedit .... Euripus ad ætatem uſque meam pervius, ac fida navigiis ſtatio, nunc, interjecta ex Vulcaniæ caminis cinerum ac lapidum mole, præcluſus eſt. Ubi ſup.

believed it was the reſidence and forge of that god *. It is however extremely probable that theſe volcanic conflagrations are much more ancient than this period; as is the iſland where they are produced, which no doubt derived its origin from fire, though its formation is concealed amid the darkneſs of the moſt remote ages.

The accounts here given of the preſent ſtate of Vulcano, clearly ſhew the miſtake of Sir William Hamilton, who compares it to Solfatara near Naples; a miſtake occaſioned by his not having viſited the iſland.

We have ſpoken above, of the opinion of many of the natives of Lipari, that it is poſſible to foretell with certainty, what winds will blow, from the different appearances of the ſmoke of Vulcano. I find that the ancients, likewiſe, boaſted the knowledge of the ſame prognoſtics. They inform us, that before a ſouth-wind blew, the iſland of

* Νομιζουσι δε οι εκειυη ανθρωποι, εν τη Ιερα ως ο Ηφαιστος χαλκευει. Thucyd. ubi ſup.

Vulcano was enveloped in a dark cloud, ſo that Sicily could not be ſeen; and that when a north-wind was to be expected, a pure flame roſe high above the crater, and the roarings were more violent; while a kind of I know not what middle ſymptoms preceded the zephyr or weſt-wind. The various ſounds of the exploſions, likewiſe, and the different places where the eruptions began, the flames, and the ſmoke, were all prognoſtics of the wind which ſhould blow after the third day. Such is the account of Polybius, who has been copied by all the writers who have ſucceeded him *.

Theſe prognoſtics, however, which the Greek hiſtorian, probably, received from the mariners, accord but little with thoſe of

* Ἐαν μεν ϑν νοτος μελλη πλειν, αχλυν ομιχλωδη καϊαχεισϑαι κυκλω φησι της νησιδος, ὥστε μηδε την Σικελιαν απωθεν φαινεσθαι. οταν δε βορεας, φλογας καθαρας απο τϑ λεχθεντος κρατηρος εις ὕψος εξαιρεσθαι, και βρομους εκπεμπεσθαι μεγας. Τον δε ζεφυρον μεσην τινα εχειν ταξιν. ἐκ τε δη της διαφορας των βρομων, και εκ τϑ ποθεν αρχεται τα αναφυσηματα, και αι φλογες, και αι λιγνυες, προσημαινεσθαι και τον εις ἡμεραν τριτον παλιν μελλοντα ανεμον πλειν. Polyb. ap. Strab. Lib. VI.

Signor

Signor Roſſi above cited, and ſtill leſs with the phenomena obſervable in Vulcano at preſent; either becauſe ſuch indicatory ſigns can no longer take place, now that the volcano is in a comparative ſtate of tranquillity; or becauſe theſe boaſted predictions originated more in exaggeration and credulity than the faithful teſtimony of the ſenſes.

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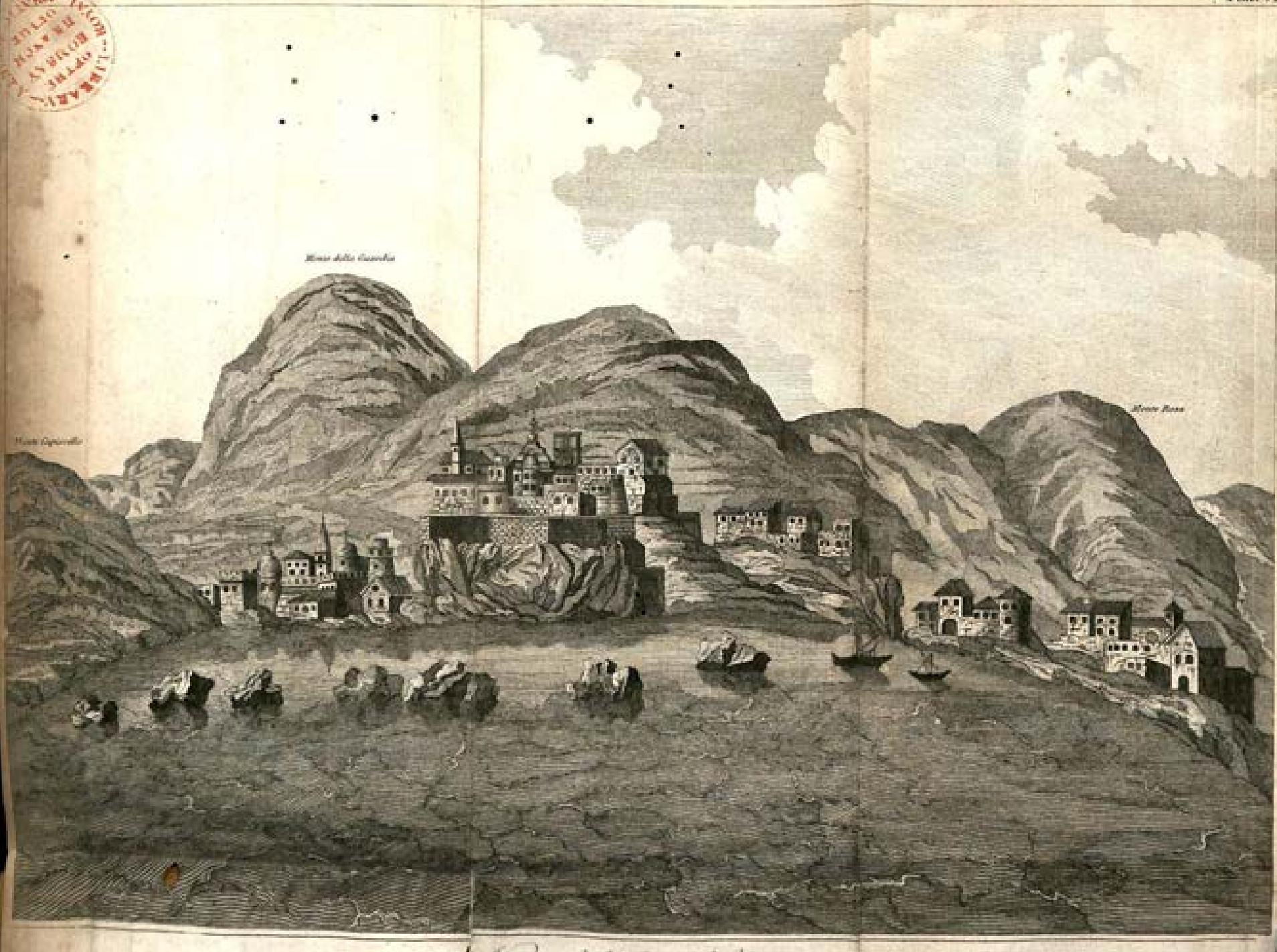

View of the City of Lipari

View of the Castle of Lipari

CHAP. XV.

LIPARI.

PART THE FIRST.

OBSERVATIONS MADE ROUND THE SHORES OF THE ISLAND.

Unavoidable delays in making the circuit of the iſland—The city of Lipari and its harbour—Immenſe rock of lava and glaſs on which the caſtle of Lipari is founded—Reaſons for believing that the internal part of this rock is a true glaſs—Other proofs of the ancient exiſtence of fire in that place, derived from the pumices of the ſame rock—Our common fire acts on volcanic glaſſes differently from the ſubterranean fires—Other obſervations made within the harbour—Porphyritic lava of a beautiful red found in its vicinity—The author leaves the harbour, and makes the circuit of the iſland, proceeding towards

the North—The enormous breaches made by the ſea in the ſhores of the Eolian iſlands extremely favourable to the diſcovery of volcanic products—Another red porphyritic lava—Extraordinary courſe of another lava—The Campo Bianco (White Field), ſo called from the white pumices of which it is an entire mountain—Their different ſpecies deſcribed in detail—Analyſis of theſe and other kinds of pumices in the humid way—Diſcuſſion of the different opinions relative to this kind of volcanic products—The Monte della Caſtagna compoſed of vitrifications and enamels—Properties of theſe—Capillary vitrifications—Others which may be conſidered as in a ſtate of tranſition from pumice to glaſs—Not probable that the glaſs paſſes into pumice, as ſome have believed—Reſemblance and difference of theſe two ſubſtances—Enumeration of ſome other kinds of glaſſes, one of which greatly reſembles what is called the Iceland agate, or gallinaceous ſtone of Peru—Glaſſy lavas of the Monte della Caſtagna—This mountain and Campo Bianco,

Bianco, with their environs, form a vitrified maſs eight miles in circuit—This vitrification more extenſive in ancient times —No characteriſtic ſign of the exiſtence of the ancient volcanos on the ſides of this mountain—Indubitable proofs, however, that ſome of the above-mentioned vitreous ſubſtances have flowed, and others been thrown up, from volcanic gulphs—Felt-ſpars and petroſilex commonly the baſe of theſe vitrifications—Queſtion, whether the vitreous parts, incorporated with or continued through the different lavas, owe their origin to a more vehement action of the fire, or to their being more eaſily vitrifiable—Singular phenomenon relative to this ſubject—Univerſal ſterility of this extenſive vitrified tract—Uncertainty of the rule which eſtimates the dates of lavas from their being more or leſs converted into vegetable earth—Multiplicity of lavas decompoſed by ſulphureous acids, and variouſly coloured by the oxyde of iron, found beyond the Monte della Caſtagna—Decompoſitions of other lavas, occaſioned by the

ſame acids, and other enamels and pumices found on the ſhores of the iſland—Extremely minute ſhoerls, and beautiful quartzoſe cryſtals, and chalcedonies, originating from filtration, in ſome decompoſed lavas—Two large rocks in the narrow channel which divides Lipari from Vulcano—This channel in ancient times muſt have been narrower than at preſent—Conjecture that it once did not exiſt, and, conſequently, that theſe two iſlands formed but one—Figure of the Monte della Guardia ſeen from the ſea—Its roots of lavas, pumices, and vitrifications — Prodigious quantity of vitreous eruptions which compoſe this mountain.

THIS iſland, from its extent, the celebrity which renders it illuſtrious, the number of its inhabitants, its commerce and agriculture, claims pre-eminence above all the others by which it is ſurrounded, and which from it derive the name of the Lipari-iſlands. Nor is it leſs important in the eſtimation of the naturaliſt, from the quantity, variety and unuſual

unuſual beauty of the volcanic products it contains. M. Dolomieu, during the four days he remained here, gathered as ample a harveſt as within ſo ſhort a time could be expected from the moſt diſcerning and indefatigable lithologiſt; but it is eaſy to conceive that he muſt ſtill leave much to be diſcovered in an iſland nineteen miles in circuit. During the eighteen days that I remained there, I may ſay that the ſickle was never out of my hand; yet I will freely confeſs that I left behind me many a handful, which I would willingly have gathered, had this volcanic iſland been leſs diſtant from my home.

For the ſake of order in my account of the obſervations I made in this iſland, I ſhall firſt ſtate thoſe which occurred to me in making its circuit, and examining its ſhores; and next, thoſe I made in its interior, and in aſcending its mountains. My remarks will thus, naturally, be divided into two parts.

PART THE FIRST.

Obſervations made round the ſhores of Lipari.

IN making this circuit, that I might perform it completely, I employed more time than I had imagined it could require. Beſides the time neceſſary for remaining with the boat at a little diſtance from the ſhore to obſerve the different courſes taken by the volcanic matters, in their way to the ſea, when liquefied by the power of the fire; beſides that conſumed in landing to examine theſe matters more nearly, and in breaking them to pieces with ſuitable inſtruments, that I might collect and preſerve them; laſtly, beſides the time requiſite to aſcend, or rather to climb up, ſteep rocks, cliffs, and precipices, which roſe from the waves, at the termination of the courſe of the eruptions; I was not a little delayed by the obſtacles which continually oppoſed the execution of my deſign. How often, when I attempted to proſecute my intended circuit while the ſea

was

was calm and ſmooth as the moſt placid lake, have I been obliged to deſiſt, and return with my boat, by a wind ſuddenly riſing, either contrary, or blowing in upon the land, ſo as to expoſe me to the danger of being driven upon the ſhore, and ſhipwrecked on the rocks! Frequently, though the ſea was ſufficiently calm for a conſiderable diſtance, yet, where the coaſt broke off, or ſunk in, I found it running high, from the remains of a ſtorm that had not long ceaſed, or, as it is termed, an old ſea, which my boat was unable to encounter without great danger. Every one who is acquainted with the ſea that ſurrounds the Eolian iſles, knows how liable it is to ſudden tempeſts.

The city of Lipari extends along the ſhore in the form of an amphitheatre. Behind it riſe a chain of mountains; and in front is its harbour, formed by the hollowing in of the ſea, which here divides the ſhore *. I omit to mention another very

* See Plate VI.

ſmall harbour to the ſouth, only fit for the reception of ſuch veſſels as may be drawn up on ſhore.

I began my reſearches in the harbour itſelf, under the caſtle of the city, which is erected on an immenſe rock of lava, that riſes perpendicularly from the water, and is entirely deſtitute of all vegetation except a few ſtalks of the Indian fig *, which grow in its fiſſures †.

This lava has for its baſe feltſpar, is of a fine and compact grain, of a ſcaly fracture, dry to the touch, and gives ſparks, like flint, with ſteel. It is of a cinereous colour, in many places approaching to that of lead. It is full of an immenſe quantity of ſmall extraneous bodies, which would be with difficulty diſtinguiſhed from the ſubſtance of the lava on account of their reſemblance in colour, were they not little glebes. This lava is

* Cactus Opuntia Linn.

† See Plate VII.

joined

joined to large maſſes of glaſs, which form a whole with it, without any diviſions or ſeparations in the middle. It therefore is the ſame lava, which in ſome places retains its nature, and in others is tranſmuted to glaſs. This glaſs, in ſome parts, contains the ſmall extraneous bodies before mentioned, but in others it is pure glaſs. In general it is extremely compact, of a dull black colour, and fractures rather in irregular pieces than in waving ſtreaks, as is uſual with glaſs. It has beſides a kind of unctuoſity to the touch, and even apparent to the eye, which is not obſervable in any other of the moſt perfect volcanic glaſſes. Like the lava, it gives ſparks with ſteel; but the lava is entirely opake, whereas the glaſs, in the angles and thinner edges, has a conſiderable degree of tranſparency. It only appears opake where it contains the minute globes, which are particles of the lava. Though the lava in the fractures has not the luſtre of the glaſs of which it is a continuation; yet, when cut and poliſhed, it is not in the leaſt inferior to it in that reſpect. I poſ-

ſeſs,

ſeſs ſeveral pieces, cut and poliſhed, which are half glaſs and half lava, and of which the different colours form an excellent contraſt.

An obſervation which I made relative to this kind of glaſs appears to me too important to be omitted.

If we take a piece of this glaſs, ſix or ſeven feet in length, and four or five thick, and attentively examine it, we ſhall diſcover that it is marked with ſmall grey veins parallel to each other, which give it the appearance of being divided into ſtrata or flakes; and if the point of a large pickaxe be ſtruck by a powerful arm into one of theſe veins, and uſed as a lever, the whole maſs will ſplit into two parts, from one end to the other, following the courſe of the vein; and with equal facility, by proceeding in the ſame manner, many new diviſions of the glaſs be obtained in the other veins, till the whole piece is divided into a number of plates proportionate to the number

of

of veins: but if we attempt to divide them in any other part but the vein, they only break into ſmall irregular fragments.

When we examine the face of one of the plates thus divided, we perceive that every vein conſiſts of a thin leaf of earthy and ſcoriaceous particles, which prevents the vitreous ſtrata from perfectly uniting. The direction of theſe veins, which interſect the glaſs tranſverſely, is, generally, from above to below; and it appears evident to me, that the plates or ſections of glaſs interpoſed between the veins have been produced by as many different flowings of the fluid matter. The formation of the earthy veins I conceive to have been as follows. The firſt ſtream, that is to ſay the loweſt of all, containing lighter and leſs fuſible particles than the remainder of the liquefied vitreous matter, theſe floated on the top; and the glaſſy current cooling, produced, or rather left on the ſurface, a firſt pulverous coating, which prevented the perfect union of the ſecond current that ſucceeded the firſt;

and

and this ſecond, containing ſimilar ſubtile matters, prevented in like manner the full adheſion of the third; and ſo of the reſt. Thus have ſucceſſive flowings of the liquid matter produced the maſſes of glaſs we now ſee, exhibiting thoſe apparent veins, in which they may be ſo eaſily ſplit. But as we ſhall have occaſion to ſpeak of other glaſſes, in another place, we ſhall then have an opportunity to reſume the ſubject of this peculiar texture.

Such were the obſervations I made on that rock, and ſome fragments which had fallen down from it on the ſhore; ſince, though it is compoſed of hard lava and glaſs, yet from the numerous fiſſures in it, cauſed by congelation, it has ſuſtained many loſſes. In fact there is danger that it may become ſo entirely ruinous as to occaſion its fall, together with that of the caſtle it ſupports.

I cannot diſmiſs this ſubject without mentioning certain circumſtances which induce

duce me to believe that the inſide of this rock is one prodigious maſs of glaſs. The waves of the ſea, by inceſſantly beating againſt it, have corroded it in ſeveral places, but eſpecially towards the middle, where they have formed a ſpacious cavern; which, as the lower part of it is covered with water, I entered in my boat, and found that the ſides were real and ſolid glaſs.

In other places, againſt which the ſea has daſhed, and more or leſs broken the rock, the ſame vitreous ſubſtance is apparent. If we aſcend from the ſhore to the caſtle, in more than one place near the road, which lies over lava, we find volcanic glaſs. In the ſmall ſquare, near the houſe of the commandant, we find it riſing above the ground in large pieces reſembling ſteps. Great maſſes of it likewiſe project from the ground within the city, in two places of which, having cauſed the earth to be dug into, I found the ſame glaſs.

All theſe facts and obſervations appear to me

me ſufficiently to ſupport my opinion, which, as I have ſaid, is, that the inſide of this vaſt rock is entirely of glaſs. We perceive therefore that though, on making the circuit of the other parts of the iſland, we ſhould not be able ſatisfactorily to aſcertain its nature, theſe facts alone would be more than ſufficient to prove it volcanic; and an intelligent though indolent traveller, who on arriving at Lipari ſhould only take the trouble to go over the city, would perceive, in a few hours, what in many other countries, once ſubjected to the action of fire, he would not be able to diſcover in a much greater number of days.

But the indubitable teſtimonies of the ancient exiſtence of fire in this place do not conclude here. The vitreous ſubſtances are frequently accompanied by pumices which are, in fact, only an imperfect glaſs. If we view the ſteep maſſes of glaſs and lava, which riſe perpendicularly from the ſea, like a wall; we perceive that they are interſperſed with different ſtrata of pumice, from

from which, by the aid of a pole tipped with iron, ſmall pieces may be broken off. On the ſhore, however, we do not find it in any great quantities.

This pumice is of two kinds, the one heavy and compact, the other light and porous, and both of a cinereous colour. The compactneſs of the former ſpecies, however, is not ſo great, but it may be broken into ſmall pieces, and crumbled into powder between the fingers. It is dry and rough to the touch, is filamentous in many places, and crackles between the teeth; qualities appertaining to common pumices. Its ſtructure is not every where filamentous, but in ſome places ſo fixed that its fibrous texture cannot be diſcerned. By the aid of the lens we perceive that it is of a vitreous nature, and diſcover an infinity of lucid points, which we might take for very minute feltſpars, did not a careful examination with a good magnifier ſhew them to be real particles of glaſs. It cannot be denied, that this pumice is of the ſame nature

with the lava of the rock, ſince we ſee, in many places, the lava gradually loſe its ſolidity and fineneſs of grain, and aſſume the characters of this ſpecies of pumice.

The other kind is rather ſcaly than filamentous, and its ſcales have a degree more of vitrification than the other; the confluence, likewiſe, of ſome of theſe ſcales has produced, in ſeveral places, ſmall lumps of a black glaſs. It is, however, extremely light in conſequence of the pores and vacuities with which it abounds. This pumice is uſually a continuation of the other, and, in my opinion, derives its origin from the greater degree of heat which it has ſuſtained.

After having examined, and attentively conſidered on the ſpot, this mixture of lava, glaſs and pumice which forms the body of the rock, it appears evident to me that there have been ſeveral currents that have flowed down the ſides, and, perhaps, from the ſummit, of the contiguous mountain della Guardia,

Guardia, into the ſea, ſince the direction of their deſcent is found on that ſide, and even the filaments of the pumices point towards that mountain.

If we except thoſe minute globules, which appear to me to be portions of lava, this lava, glaſs and pumice, exhibit neither feltſpars, ſhoerls, nor any other extraneous body; either becauſe theſe have been melted by the fire, or, perhaps, becauſe they never exiſted in them. But in what manner this fire muſt have acted in fuſing thoſe maſſes of feltſpar of which the rock that ſupports the caſtle of Lipari is formed, ſo that this ſtone ſhould now have remained a ſimple lava, and now have paſſed into the ſtate of glaſs or pumice, ſhall be conſidered in another place; at preſent I ſhall proceed to ſtate other facts analogous to the ſame ſubject.

The lava and glaſs of the rock, when expoſed to the furnace in ſeparate crucibles, fuſed into a light-grey glaſs, the globules which before appeared in them melting at

the ſame time. This glaſs is incredibly porous. Though the crucible in which theſe ſubſtances were fuſed was only filled to one quarter part of its contents, they ſwelled ſo much when in a ſtate of liquefaction, that they roſe ſeveral lines above the edges of the crucible, and flowed over down its ſide.

The two kinds of pumice, though both derive their origin from the ſame feltſpar, which is the baſe both of the lava and the glaſs, afford different reſults in the ſame fire; ſince their volume, inſtead of augmenting, is diminiſhed; only retaining its former colour.

The tumefaction or inflation of this glaſs may, perhaps, excite ſome ſurpriſe; ſince it implies a prodigious quantity of gaſeous bubbles contained within it; whereas nothing of the kind is obſervable in it, when it is acted on by the fire. But we ſhall ſee hereafter that this is an appearance common to almoſt all glaſſes and compact vol-

canic

canic enamels, and which I ſhall conſider when I come to ſpeak of the nature of the gaſeous ſubſtances that frequently tumefy more or leſs different volcanic products: at preſent my object is only to ſtate and compare facts. I ſhall only ſay that I have never met with any thing ſimilar in the refuſion, not only of common factitious glaſs, but even of that which is ſometimes produced in the furnaces for baking bricks and tiles. A few years ago a large piece of glaſs was put into my hands which was ſaid to be volcanic, but of which I entertained doubts, ſince, though in its great weight and hardneſs it reſembled the volcanic glaſſes, it differed from them in certain ſpots and blueiſh ſtreaks, and in a kind of little ſtars, which ſeemed to indicate a principle of cryſtallization in this glaſs; neither of which appearances I ever obſerved in the glaſſes of volcanos; and on a careful examination, to diſcover with certainty its origin, I found that this glaſs had been brought from a tile-kiln. When re-melted in a glaſs furnace it retained its former ſolidity

and compactneſs, without exhibiting the ſmalleſt pore or bubble; and inſtead of ſwelling in the crucible, and aſſuming a convex ſuperficies, it ſunk, and acquired a concave one. I have obſerved the ſame in two other ſimilar glaſſes.

The haven of Lipari forms a curve in the ſhore which to the ſouth begins at the foot of the Monte Capiſcello, and ends to the north-eaſt at the bottom of the Monte della Roſa *. After having therefore examined that part of the ſhore which is contiguous to the harbour, lying under the caſtle, and on the right ſide of Monte Capiſcello, I made the circuit of the remainder of that curve to the baſe of Monte della Roſa. The objects which here attracted my notice were firſt a tufa above a lava, which the induſtry of the inhabitants had converted into a ſoil ſuitable to ſmall vineyards; and next a maſs of crags and precipices, partly fallen into the ſea, and partly threatening to fall,

* See Plate VI.

among

among which, beſides ſcoriæ of an iron colour, we meet with beautiful volcanic breccias of a lava of a petroſiliceous baſe, and containing ſmall particles of glaſs and pumice.

I cannot think of this place without ſhuddering at the dreadful danger to which I ſhould have been expoſed had I viſited it two days later. I was there on the 21ſt of September, and examined the breccias which had fallen down on the ſhore, and thoſe, much more numerous, and more deſerving attention, which remained ſtill attached to the rugged declivity that deſcends into the ſea. On the 23d, in the afternoon, almoſt the whole of this declivity fell down with a dreadful craſh. I was at that time taking my afternoon's nap in the houſe which had been politely appointed for my reception by the Conſul of Lipari, and is ſituated on the ſhore of the harbour. The noiſe immediately waked me, and at firſt I could not tell whether it was a violent clap of thunder, an earthquake, or the roaring of the waves in a tempeſt. I ran to the window,

and perceived that it came from the declivity I have deſcribed, but could diſcern nothing but an immenſe cloud of duſt by which it was covered. The noiſe laſted, perhaps, five minutes; and when the cloud of duſt had ſomewhat diſperſed, I perceived it was occaſioned by a prodigious quantity of ſtones that had fallen down into the ſea, and that a great number continued ſtill falling.

Two ſenſations, on this occaſion, moſt powerfully affected my mind; the one of ſhuddering and horror on reflecting that my deſtruction muſt have been inevitable had I poſtponed my viſit to this place two days and a half, and the other of ſatisfaction and joy at my fortunate eſcape.

The fall of ſo great a quantity of ſtones, produced a large longitudinal furrow in the declivity, and a ſmall indentation in the ſea. The next day I procured ſeveral of theſe ſtones, and found that they were pieces of lava, partly of the horn-ſtone baſe, and partly

partly of that of felt ſpar. The latter had a fine grain, and ſome tranſparency when in thin pieces; the former were of a coarſer grain, and opake. When I went in the boat to examine the part of the mountain where theſe ſtones had fallen, I perceived that it was formed of looſe volcanic ſtones, which were very liable to fall from the ſteepneſs of the declivity, and I judged them to be fragments of lava, detached, by length of time, from a more elevated rock, and afterwards accumulated below, at a little diſtance from the ſea.

Having arrived at the foot of the Monte della Roſa, where, as I have ſaid, the harbour of Lipari ends, I perceived on the ſhore a ſtone, which, from its ſingularity, drew my attention. It forms a rock that in part riſes above the ſea, and in part is concealed by the water. There are alſo ſeveral detached pieces of it which have been made round by the action of the waves. I, at firſt, took it for a jaſper. Its ground was of a blood-red colour; it gave ſparks ſtrong-

ly with ſteel, was of a rather fine grain, and had almoſt the hardneſs of quartz. When I firſt ſaw it, it reminded me of the jaſper I had obſerved and collected at Schemnitz in Lower Hungary, under the hill Calvario, and of which ſome ſpecimens are preſerved in the Imperial Muſeum, it appearing to me that theſe two ſtones were extremely ſimilar; but on a more attentive examination, I perceived that this ſtone was not ſimple like the jaſper, but of a compound formation, containing in it reddiſh ſcales of felt-ſpar, and ſhoerls, which gave it the character of that kind of porphyry which has for its baſe a hard horn-ſtone. But is this porphyry in a natural ſtate, or in that of lava? Lavas of a red, and a bright red, colour, I confeſs, I had never before ſeen, nor do I know that they have been obſerved by any other naturaliſt; and I therefore doubt whether the detached red porphyry I found at Stromboli had ever ſuffered the action of the fire. It is true that many lavas near the ſtoves of Lipari and elſewhere have this colour, as we ſhall ſee in the following chapter;

ter; but this ariſes from the decompoſition they have ſuffered by the force of ſulphureous acids, and the action of iron: and I ſhall there ſhew that the red colour (and the ſame may be ſaid of the white, green, and other colours) has only penetrated as far as the action of theſe acids, and, conſequently, the decompoſition, has extended; but where the lava remains untouched by them, it ſtill retains its natural colour, that is, either a grey, or the colour of lead or iron, but without any mixture of red. We do not, however, diſcover any traces of decompoſition in the production of which I now ſpeak. After the moſt careful examination, I cannot exclude it from the number of true and real lavas; though, on the other hand, I am unable to affirm that its redneſs is an effect of calcination, as is the caſe in other lavas, ſince of this it does not exhibit the ſlighteſt indication. We muſt here, therefore, have recourſe to one of thoſe limitations which experience has obliged us to admit in many other rules of philoſophy, which were at firſt thought to

be abſolutely general, but afterwards found to be ſubject to more than one exception. The reaſons of fact on which I found my aſſertion, that this porphyritic rock has paſſed into the ſtate of lava, are two: the great number of minute cells it contains in many parts of it, and the direction of thoſe cells. Where local circumſtances are inſufficient to determine, the compact lavas rarely leave the enquirer in doubt whether they derive their origin from fire, as the fire has not ſo changed them as to deſtroy the characters of the ſtone from which they were produced. But it is not the ſame with the cellular, ſince it is known that their configuration can only be the effect of aëriform fluids, put in motion by the action of the fire. This cellular conformation is found in the preſent ſtone. The cells in many large pieces are ſo numerous, as to occupy nearly one half of the volume of the ſtone. The largeſt are about five lines, and the ſmalleſt a quarter of a line; but between theſe two extremes there are an infinity of intermediary ſizes. It is worthy of remark, that

theſe

theſe cells are not only ſuperficial, but extend into the internal part of the maſs, as is ſeen in fractures two or three feet in depth, which may ſerve to obviate the objection that even ſtones not of volcanic origin, are ſometimes cellular, ſince it is known that their cells or minute cavities are merely ſuperficial, and originate from the corroſion of ſome of their external parts, by the filtration of the rain water. This proof is ſupported by another ſtill ſtronger, taken from the direction of the cells, which is the ſame in all, as well in the pieces detached from the rock, and deprived of their ſharp edges by the waves, as in the rock itſelf. This direction is every where found to be from the Monte della Roſa to the ſea, as they form ellipſes more or leſs acute, the greater diameters of which are invariably in that poſition, and this greater diameter is frequently twice or three times the length of the leſs. This ſtone, therefore, is not only a true porphyritic lava, but it is evident that it once flowed from the mountain above mentioned to the ſea, and in its motion

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the naturally circular figure of its pores or cells was changed into an oval. I have almoſt always obſerved the ſame appearance, on a ſmaller ſcale, in re-melted lavas, and glaſſes. As long as the matter in fuſion remains within the crucible, the bubbles are orbicular, but become elliptical in that part of it which overflowing the edges runs down the ſide of the crucible; and the greater diameter of theſe ellipſes is generally in the direction of that ſide.

All the pieces of this kind of lava are not, however, of a blood-red colour; ſome of them are of a duller red, though the component principles of both are eſſentially the ſame.

This lava, when fuſed in the furnace, doubled its volume, and its upper part aſſumed a vitreous convexity, which was ſmooth, ſhining, ſemi-tranſparent, and of a greeniſh tincture; but internally it was a very black vitreous ſcoria, extremely porous, and ſufficiently hard to give ſparks with ſteel.

With

With theſe obſervations on this uncommon ſpecies of lava, I ſhall conclude the account of my tour round the harbour of Lipari, which may extend about two miles. According to my propoſed plan, I was now to proceed to make the circuit of the iſland, which I did, taking my departure immediately from the foot of Monte della Roſa, and proceeding towards the north.

At the diſtance of ſomewhat more than three hundred feet a lofty rock riſes from the ſea, of a horrid and dreadful aſpect, formed of large plates of ſtone, feebly ſupported by projecting points, and appearing to hang in the air, and threatening to fall, as many have already, the fragments of which are ſeen on the ſhore. I muſt candidly confeſs, that, after the fall of the rock I have already mentioned, I approached this with no ſmall dread. My ardour to make ſome new diſcoveries, however, triumphed; and, as I was afterwards frequently obliged to riſk myſelf in ſimilar ſituations, in order to examine accurately the

the ſhores of the iſland, I gradually acquired an habitual courage, and became almoſt incapable of any idea of danger. I hope I may be pardoned this little digreſſion.

The Eolian iſles, eſpecially Lipari, Felicuda, and Alicuda, are, at their baſes, more or leſs corroded by the ſea, which, there, is ſo frequently in a ſtate of violent agitation. The lower excavations cauſe the parts above them to give way, and, in a ſeries of years, great maſſes fall into the ſea. To this the nature of the lava, which is full of cracks and fiſſures, conſiderably contributes; not to mention the influence of the humidity of the atmoſphere, and other deſtructive elements. Large heaps of theſe fragments, in conſequence, accumulate on the ſhore, where they are diſperſed by the waves, and make room for others, and thus a gradual diminution of the iſland takes place.

Theſe corroſions of the water, theſe fiſ-

ſures,

ſures, and fragments of the ſtones and rocks are, however, peculiarly intereſting to the enquiring naturaliſt, who, though he may make important diſcoveries while traverſing the ſummits and ſides of volcanic regions, can never penetrate beyond the ſurface. The internal effects of the fire, the ſubſtances more or leſs modified by it, and ſometimes prodigiouſly changed, even to the entire annihilation of the character of the original ſtone, and many other combinations produced in the ſubterranean receſſes, by this ever active element, can only be known by incavations and fractures which exceed the ſtrength of man to effect, but which, to a certain degree at leaſt, are in many places produced by the ſea. Of this we have already mentioned ſome inſtances, obſerved in making the circuit of the ſhores of the other iſlands, and ſhall adduce others in thoſe which yet remain to be deſcribed; we have alſo a very remarkable example before us, in the half-deſtroyed rock of which we are now ſpeaking.

Above,

Above, it is covered with a thick coating of earth, which prevents its true character from being viſible; but on the ſhore it may be very diſtinctly ſeen, and appears to be formed of a lava, in thick ſtrata, taking an oblique direction to the ſea. This lava is likewiſe porphyritic, of a petroſiliceous baſe, containing cryſtallized feltſpars, and, like the other rock I have before mentioned, of a red, but rather a dull red colour. It is not in the leaſt porous, but extremely compact and ſolid, and is conſequently extremely heavy, and rather of a ſiliceous than earthy grain. It lies on the ſhore, in large pieces; the ſolidity and beauty of which, when well poliſhed, would render it a no leſs ſplendid ornament in buildings than the porphyries which are not volcanic.

The degree of heat which fuſes the other porphyritic lava is only ſufficient to ſoften the preſent, and make it take the ſhape of the inſide of the crucible and adhere ſtrongly to its ſides. It then aſſumes a black colour, and loſes its compactneſs, becomes

filled

filled with small round bubbles. In a more intense heat, it melts into an enamel, in like manner black and filled with bubbles: the feltspars, however, remain untouched, as in the enamel produced from the other porphyritic lava.

Continuing my tour beyond the harbour and the porphyritic rock, I found the sea form a kind of bay within the land, round which a few cottages are built, affording shelter to a small number of inhabitants who live by the profits of a vineyard that but ill repays their labour. The name of this place is Cannoto; and above it is a current of lava, of an argillaceous base, similar to that of the Arso in Ischia*. This lava is not continued without interruption; but, like that of Ischia, broken, unequal, and here and there raised into a kind of little hills. Its external appearance is, on a larger scale, that of a field ploughed, with several furrows in an irregular direction, having great hillocks and

* See Chap. V.

deep intervals between them. I have obſerved this appearance in ſeveral other lavas, beſide the preſent, and that of the Arſo; and the cauſe of ſuch a conformation may, it appears to me, be the following. It frequently happens that the lavas, when they flow, meet with impediments in their way which obſtruct their courſe. When, therefore, ſuch an obſtacle occurs, the ſtream muſt ſtop, or its motion become ſlower; but this not taking place in the parts behind, they continue to flow, and increaſe the quantity of the lava, which ſwells in that place, and, in conſequence of its contact with the cold air, ſoon loſes its fluidity, and is congealed into ſtone. The liquid lava, in the mean time, takes its courſe another way, if the obſtacle is inſurmountable; and if it meets with others, new ſtoppages or retardations are the conſequence, producing other tumors; and thus the lava, in many places, becomes full of hillocks. It may likewiſe be, that the lavas, flowing over places abounding with cavities, of which there are many in volcanic mountains, may partly ſink into them,

them, and, thence, afterwards rise somewhat above the former level; and thus produce the small elevations which are here observable.

I had now continued my tour, in the boat, till I approached Campo Bianco (the White Field), distant three miles from the haven of Lipari, and so called because it is a lofty and extensive mountain composed entirely of white pumices. When seen at a distance, it excites the idea that it is covered with snow from the summit to the foot. Almost all the pumices that are employed for various purposes in Europe, are brought from this immense mine; and Italian, French, and other vessels continually repair hither to take in cargoes of this commodity: the captain of the ship which had brought me to Lipari, had sailed from Marseilles to carry back a freight of this merchandize. I was not, however, actuated merely by those motives of curiosity that might induce any traveller to visit this remarkable mountain; I proposed to examine it with the eye of a philosopher and a naturalist.

The pumice-ſtone, with reſpect to its origin, though univerſally admitted to be the product of fire, is one of thoſe bodies which have divided the opinions of chemiſts and naturaliſts both ancient and modern. It may, in fact, be affirmed that it has given riſe to as many hypotheſes, and extravagant ſuppoſitions, as the queſtion, formerly ſo much agitated, relative to the nature of the yellow and grey amber. Without noticing the more abſurd of theſe, I ſhall only mention that Pott, Bergman, and Demeſte imagined that pumices were amianthuſes decompoſed by the fire; Wallerius, that they were coal or ſchiſtus calcined; Sage, that they were ſcorified marles; and, laſtly, the Commendator Dolomieu, that they were granites rendered tumefied and fibrous, by the action of the fire and aëriform ſubſtances.

The moſt effectual method to investigate the truth in ſo obſcure a queſtion, appeared to me, to make the moſt accurate and minute obſervations on the ſpot; to collect and attentively

attentively examine the pumices most suitable to this purpose; and to make further experiments on them after my return to Pavia; which practice I likewise observed with respect to the other volcanic products.

Campo Bianco is a mountain that rises almost perpendicularly from the sea, and which, seen at a distance, appears to be about a quarter of a mile in height, and above half a mile in breadth. No plants grow on it, except a few which bear no fruit, and likewise grow on the tops of the Alps. Its sides are streaked with a great number of furrows, that grow deeper and wider as they approach the bottom, and have been formed by the rains, which easily corrode and excavate a substance so soft and yielding as pumice *. The sea at the foot of it has likewise occasioned great devastations, by means of which we discovered a large vein of horizontal lava on which the last waves die away when the sea becomes

* See Plate VIII.

calm. The formation of this lava was, therefore, prior to the vaſt accumulation of pumices which reſt upon it.

On attentively viewing this prodigious maſs of pumice, we ſoon perceive that it is not one ſolid whole, and forming only one ſingle piece; but that it is an aggregation of numerous beds, or ſtrata, of pumices, ſucceſſively placed on each other; which beds are diſtinguiſhable by their colour, and in many places project from the mountain. They are almoſt all diſpoſed horizontally, and their poſition is not diſſimilar to the ſtratifications ſo frequently met with in calcareous mountains. Each bed of pumices does not form a diſtinct whole, which might lead us to ſuppoſe that they had flowed at different intervals, and every current produced a bed or ſtratum; but it conſiſts of an aggregate of balls of pumice united together, but without adhesion. It is hence evident that the pumices were thrown out by the volcano in a ſtate of fuſion, and took a globoſe form in the air, which

which they preſerved at the time of their ſudden congelation. We find many ſuch eruptions of pumices in the Phlegrean Fields; as, for example, that which overwhelmed and buried the unfortunate town of Pompeii. The excavations which have been made, to exhibit to view ſome parts of that city, manifeſtly ſhew, that repeated ejections of ſmall pumices in immenſe quantities from Veſuvius, have covered it with vaſt accumulations of that ſubſtance, diſpoſed in different beds or ſtrata.

A great quantity of theſe Lipareſe pumices, of a globular form, are firſt met with on the ſhore near Campo Bianco; but as I doubted whether the action of the waves might not concur to produce the roundneſs of their figure, I rather choſe to make my obſervations on thoſe that actually formed the beds, which I did, by climbing up one of the ſides where the aſcent, though difficult, was not impracticable. Here I found pumices approaching ſome more, ſome leſs, to the globular form, and

of different ſizes, ſome not being larger than nuts, and others a foot or more in diameter, with innumerable ſizes between theſe extremes. Though the ground-colour of them all is white, in ſome it inclines to yellow, and in others to grey. They ſwim in water, do not give ſparks with ſteel, nor cauſe the leaſt motion in the magnetic needle. Their fracture is dry and rough to the touch, their angles and thinner parts are ſlightly tranſparent; and their texture, in all of them when viewed through the lens, appears vitreous; but this texture has diverſities which it will be proper to ſpecify.

Some of theſe pumices are ſo compact that the ſmalleſt pore is not viſible to the eye, nor do they exhibit the leaſt trace of a filamentous nature. When viewed through a lens with a ſtrong light, they appear an irregular accumulation of ſmall flakes of ice; their compactneſs, however, does not prevent their ſwimming on the water.

Others are full of pores, and vacuities of a larger

a larger ſize, uſually of a round figure; and their texture is formed by filaments, and ſtreaks, in general parallel to each other, of a ſhining ſilver whiteneſs; and which, at firſt view, might ſeem to be ſilken, did they not preſent to the touch the uſual roughneſs of the pumice.

Theſe varieties are not only obſervable in different globes of pumice, but frequently in the ſame: it is therefore indubitable that theſe differences are not intrinſical and eſſential to the nature of pumices, but accidental, and ariſing from the action of aëriform fluids, which, dilating them in many places, when they were in a ſtate of fuſion, have produced that multitude of pores, and thoſe filaments and ſubtile ſtreaks, that denote a ſeparation of the parts; whereas the other pumices, which have not been acted on by theſe gaſes, have preſerved that compactneſs which reſults from the force of aggregation.

The fractures of the compact pumices are,

are, in ſome places, ſhaded with a blackiſh, but at the ſame time ſhining, tinge; which, when carefully examined, is found to be cauſed by a greater, though ſtill a very ſlight, degree of vitrification of the pumice itſelf; either becauſe the fire has there acted with ſomewhat more force, or becauſe the parts were, there, more eaſily vitrifiable.

The pumices hitherto deſcribed, form one of the ſpecies which the Lipareſe ſell to foreign traders.

None of theſe, ſo far as can be diſcerned by the eye, or even with the aſſiſtance of the lens, contain any extraneous bodies; but were we too haſtily to conclude that they really do not, we ſhould commit an error, as their vitrification by artificial means will prove. When kept in the furnace during an hour, they become only more friable and of a reddiſh yellow colour; but when continued in the ſame heat for a longer time, they condenſe into a vitreous and ſemi-tranſparent maſs, within which appear a number of

of ſmall white feltſpar cryſtals that were not viſible in the pumice, becauſe they were of the ſame colour. Theſe ſtones, however, are not ſeen in every pumice thus fuſed; either becauſe it did not contain them, or becauſe they have melted into one homogeneous maſs with the pumice. This is one of the many important caſes in which we are able, by the means of common fire, to diſcover the compoſition of volcanic products which had at firſt been ſuppoſed to be ſimple.

But to render complete my enquiries relative to the pumices of Campo Bianco, it was neceſſary that I ſhould not confine my reſearches merely to the part of the mountain I have mentioned, but extend them to all the principal places where they might be found. This I did, accompanied by two natives of Lipari, whoſe aſſiſtance was particularly uſeful to me, as they lived by digging pumice, and were well acquainted with every part of the mountain, and the different kinds of pumices it contained. It

is impoſſible to deſcribe the difficulties I met with in theſe excurſions. We frequently paſſed along the edges of the deep ditches made by the rain-water, at the hazard, in caſe of a falſe ſtep, of falling into them, and not eaſily getting out again; or the ſtill greater danger of precipitating into the ſea. The dazzling whiteneſs of the pumice, equal to that of ſnow, increaſed my fears; for I made my excurſions in the day-time, when the ſun ſhone, and was ſtrongly reflected by theſe ſtones. Every one knows that ſnow, beſides dazzling the ſight, is accompanied with the inconvenience, when it is deep and has lately fallen, that the perſon who walks on it ſinks into it to a greater or leſs depth; and the ſame inconvenience is experienced from the pumice, which in many parts of Campo Bianco is reduced to a powder ſeveral feet deep, and, when the wind blows on it, ſinks in on one ſide, and is heaped up on the other. All theſe difficulties and obſtacles I, however, ſurmounted, animated by that ardour which inſpires the philoſophical traveller, and enables him

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to brave the greateſt dangers, and ſuch as can only be known and appreciated by thoſe who have engaged in ſimilar undertakings. I can affirm, therefore, with great ſatisfaction, that with the aſſiſtance and guidance of the two Lipareſe, there was no corner of the mountain that I did not viſit; and when I reached the ſummit, and ſaw that it joined another mountain, the foot of which was in the ſea, and which was, in like manner, compoſed of pumice, I extended my reſearches to that likewiſe, and examined the different ſpecies of pumice it afforded, or rather which compoſe a very conſiderable part of it. I ſhall proceed to deſcribe them ſeverally, with as much brevity as poſſible.

I ſhall firſt mention thoſe which conſtitute a branch of commerce at Lipari, and are applied to various purpoſes. One of theſe has already been ſufficiently deſcribed: I ſhall only add, that it is found in conſiderable quantities in Campo Bianco, but ſolely in detached pieces, and not forming currents

or

or veins; whence it is evident that it has been ejected from the volcano, and has not flowed in the manner of lava.

The ſecond ſpecies is cut by the labourers in parallelopipeds, about twenty-two inches long, and eight broad. This pumice is of a dark dirty colour, contains no extraneous bodies, gives a few ſparks with ſteel, and is ſo light that ſome pieces of it will float on the water. It is formed by an agglomeration of pumiceous bubbles, which are, as it were, conglutinated together, and incline more or leſs to an oblong figure. To detail their various ſizes, would be uſeleſs prolixity. I ſhall only ſay, that from the very minute, and, if I may ſo term them, infiniteſimal, they increaſe in ſize till ſome of them exceed an inch in diameter, though the latter are leſs numerous than the former. They are all extremely friable, as their ſides are very thin, and always ſemi-vitreous. The glaſs of many of them is white, and has ſome tranſparency; but in others is dull, and almoſt entirely opake.

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As I do not know that this ſpecies of pumice has ever been deſcribed before, though it certainly well deſerves attention, I would wiſh my deſcription to be as clear and explicit as poſſible. It has been already ſaid, that many lavas, and other volcanic productions, on re-fuſion, become cellular. To apply this to the pumice in queſtion would be an error. A lava, which has undergone this change by the action of elaſtic gaſes, continues to form one whole, though interrupted by theſe multiplied pores. The pumice, of which I now ſpeak, is principally formed by an accumulation of ſmall vitreous veſicles, which attached themſelves to each other while they were yet ſoft from the action of the fire; and which, from their globoſe figure, not adhering except in a few points, have left many vacuities very viſible on the fracture of the pieces. The labourers who dig theſe pumices, after they have ſhaped them into parallelopipeds, take them on their backs and carry them down to the ſhore, where they pile them up in large heaps, to be ready

ready for ſale when opportunity ſhall offer. We are not to imagine, however, that this ſpecies of pumice is to be found in every part of the mountain: the workmen, to find what they call the vein of it, are obliged to make great excavations, and frequently without ſucceſs; which, as they told me, in this caſe, as in fiſhing for coral, often depends on chance. When they have found the vein, they dig it, following its direction; in which laborious employment a number of men are occupied for whole weeks, the vein being ſometimes a hundred and fifty, two hundred, or even three hundred feet long, and large in proportion. Theſe veins are called *Faraglioni*. I have examined them, and ſatisfied myſelf, that the accounts I received were true. Pumice-duſt, and large heaps of the firſt ſpecies of pumice, with ſome ſcattered vitrifications, uſually cover theſe veins, which, when viewed with the attentive eye of the naturaliſt, give reaſon to believe that they are long tracts of pumice, which once flowed in a liquid ſtate. Their bubbles frequently lengthened

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in the direction of the vein, ſeem, likewiſe, to prove the ſame.

M. Dolomieu, who firſt ſuggeſted that many pumices have flowed in currents like lavas, obſerved that, at Campo Bianco, the lighter pumices lie above the heavier; in the ſame manner as in the common currents of lava the porous lavas occupy the higheſt place. I have certainly obſerved this diſpoſition; but ſometimes it proves fallacious: for, if the excavation be continued below the vein which forms the ſecond ſpecies of pumice, we frequently again find maſſes of extremely light and pulverulent pumice.

The firſt action of the fire of the furnace thickens the ſides of the vitreous veſicles, of the ſecond ſpecies, and diminiſhes the internal pores. A longer continued heat entirely annihilates the pores, and changes the pumice into a fixed, obſcure, homogeneous, and hard glaſs, which gives ſparks plentifully with ſteel.

The third ſpecies is likewiſe an object of traffic with the natives of the iſland, who dig it in the ſame places where they find the ſecond; and, in like manner, ſhape it into parallelopipedons. This is likewiſe an aggregate of bubbles, but differing from thoſe of the former in ſeveral reſpects. Thoſe, as we have ſeen, are conglutinated together in ſome points, while they are ſeparate in others, ſo that we can frequently detach them without breaking; while theſe, on the contrary, are ſo incorporated by different ſolid points, that, if we attempt the ſeparation of one, we break the others that are contiguous. Here the elaſtic gaſes, inveſting the pumiceous ſubſtance in ſeveral points, have expanded it in every part into tumors and cavities, nearly as we ſee in raiſed and baked paſte. It is worthy remark, that, frequently, when we break one veſicle, we meet with another within it, and concentrical. There is likewiſe another difference between theſe two pumices. The veſicles of the ſecond ſpecies are all more or leſs vitrified; but many of the third ſhew

no

no ſigns of vitrification, are extremely friable, and of a pale red colour.

This pumice, though deſtitute of any fibrous texture, is ſpecifically lighter than water. To obtain it, large pieces of white pumice, of the firſt ſpecies, in which it is enveloped, muſt be removed; and it commonly lies in long tracts, in the direction of which its veſicles are ſometimes lengthened, which may induce us to ſuſpect that this likewiſe, when it was liquid, formed ſmall currents. It contains no extraneous bodies.

In the furnace it condenſes into an obſcure maſs of glaſs, almoſt opake, but little porous, and ſufficiently hard to give ſparks with ſteel.

Theſe are the three kinds of pumice which the people of Lipari dig for ſale. The firſt is employed in poliſhing different ſubſtances, and the other two are uſed in the conſtruction of arched vaults, and the

corners of buildings. There are, however, other ſpecies which deſerve the attention of the naturaliſt, and which I ſhall here proceed to deſcribe.

On Campo Bianco, and in its environs, we find a fourth ſpecies of pumice, of a filamentous and extremely black texture. It is rough to the touch, ſcarcely at all porous, ſo heavy as to ſink in water, and gives ſparks moderately with ſteel. This pumice likewiſe contains no extraneous ſubſtances. Though when viewed in the maſs it appears entirely opake; its filaments when detached, and examined by a ſtrong light, appear to be tranſparent, and only dark from their black colour. The ſecond and third ſpecies are veſicular; but in this there are not any veſicles. The threads or filaments of which this fourth ſpecies is compoſed, have all one direction, which is that of the current. It is here neceſſary to obſerve, that though this black pumice is found ſcattered on the ſides of Campo Bianco; in a rock which deſcends almoſt perpendicularly into

into the ſea, it forms an entire vein almoſt horizontal, which enlarges from the breadth of ſeven feet to twelve, and is above ſixty feet in length. If we here examine the ſtructure of this pumice, we ſhall find that, beſides being filamentous, as we have before deſcribed it, its filaments preſerve a parallelism among themſelves, and the direction of them all is from the mountain to the ſea; there can therefore be no doubt but this vein may be conſidered as a true current of pumice.

I was at firſt inclined to believe that the black colour of this pumice proceeded from iron, but afterwards ſuſpected that it was rather the effect of a bituminous ſubſtance, from the ſtrong ſcent of bitumen which it emitted on rubbing two pieces of it together, and my ſuſpicion was afterwards confirmed by its loſing its black, and acquiring a white colour, by remaining a ſhort time in the furnace: on a longer continuance it became a vitreous paſte.

But among the different productions of this nature, there is none which more merits attention than that of which I now proceed to ſpeak, and from which originate no ſmall part of the pumices of Campo Bianco. This is a lava, with a feltſpar baſe, which is found over the whole mountain and its environs, riſing in rocks and crags of an enormous ſize. It is of a grey colour, of an appearance between ſiliceous and vitreous, with a conſiſtence or grain leſs fine than that of quartz, having a ſmall degree of tranſparency in the angles, and ſufficient hardneſs to give ſparks with ſteel. On attentively examining this lava, we may diſtinctly perceive in it the gradual tranſition of the lava into pumice. In many pieces of it we find the external appearances above deſcribed. In others the lava begins to ſoften, and become friable and rough to the touch, but without loſing its ſiliceous-vitreous appearance. In many others we diſcover the commencement of the pumiceous character. Some ſmall cavities in this lava exhibit minute groups of fibres, of a ſilvery whiteneſs,

whiteneſs, light, extremely friable, but only diſcernible by the lens. Theſe crackle between the teeth, and rub to powder under the finger; but, at the ſame time, ſhew they have a rough grain, and, in a word, prove, by the moſt indubitable marks, that they are real pumice. On breaking other pieces, the groups or cluſters of fibres are found more fixed and large, ſo as to occupy a great part of the lava, which becomes lighter even where there are none of theſe cluſters, ſince its texture becomes thinner, though not at all porous; and here the nail only is ſufficient to ſcratch and break them, and the eye accuſtomed to pumices recognizes the characteriſtic marks of that ſubſtance, though they are not ſo apparent as in the filamentous aggregates. Laſtly, it is not uncommon to find maſſes of lava, which on one ſide retain the characters of feltſpar, and on the other are changed into the firſt ſpecies of pumice, entirely reſembling it in colour, lightneſs, ſtructure, and its other exterior characters. In this pumice we likewiſe perceive many cryſtallized feltſpars,

ſuch as we find them in the generative lava, and ſeemingly not at all injured by the fire.

We thus clearly diſcover the origin of the firſt deſcribed ſpecies of pumice. I muſt here remark, likewiſe, that theſe maſſes of lava, even where they do not appear pumiceous, if they are triturated and pulverized, produce a powder reſembling in every reſpect, the whiteneſs of its colour not excepted, that which, in immenſe quantities, covers, and lies deep in the mountain, and which is produced from the pumices of the firſt ſpecies. The furnace reduces this pumice to a kind of glaſs, reſembling that obtained from the firſt ſpecies.

All theſe circumſtances concur to prove the identity of this pumice derived from the feltſpar, with that firſt deſcribed. I ſhall only obſerve, that if the greater part of this kind of pumice has not formed currents, but been thrown out, at different times, in detached pieces from the volcanic

as has been before remarked, another portion has actually flowed; that, for inſtance, which in many parts of Campo Bianco is united to the feltſpathoſe lava.

This lava, however, merits to be conſidered in another point of view. Hitherto we have only noticed it as the original baſe of pumice, but we ſhall likewiſe find it productive of glaſs. To be convinced of this, we have only to examine ſome other pieces from the ſame mountain; ſome of which, without loſing the appearance of the feltſpar, begin to aſſume the veins of glaſs, and are at the ſame time filled with innumerable ſmall bubbles, that are likewiſe vitreous. But this glaſs differs from that of the pumices by being more perfect, and more tranſparent. In other pieces the bubbles are larger, and the ſmall vitreous veins more numerous. On breaking a large maſs, or following the large veins, we find in ſome parts groups of feltſpathoſe lava, in others pieces of veſicular glaſs, and in others ſolid glaſs.

But

But whence has it happened that the ſame rock in ſome places has been changed into pumice, and in others has become glaſs? ſince, though the greater part of pumices are vitreous, their glaſs is far from being ſo perfect as that in queſtion; which likewiſe differs from the pumices in this, that though it forms veſicular maſſes, theſe maſſes have a hardneſs that can never be compared with the uſual friability of pumices.

The origin of this difference, it appears to me, may be explained as follows: A certain degree of heat has produced a ſemi-vitrification in the feltſpar, which has changed it into pumice. Such a degree of heat therefore was only ſufficient for the production of this ſtone; but a ſtronger, or, perhaps, a longer continued heat, has produced a complete fuſion, that is, a perfect glaſs, ſometimes abounding in bubbles, from the abundance of the gaſeous ſubſtances with which it is penetrated.

Seven varieties of theſe cellular glaſſes,

which are all of a cinereous colour, having been expoſed for ſeveral hours to the furnace, on their re-fuſion, were reduced in volume, and the new glaſs was conſequently deprived of that multitude of pores it before contained.

But to return to the pumices: we have now aſcertained that there are four ſpecies, of which Campo Bianco and its environs are principally compoſed.

It may, perhaps, be objected, that the ſecond and third ſpecies which I have deſcribed, do not properly belong to the claſs of pumices, as they are both veſicular; whereas, one of the characters of the pumice is the filamentous texture.

I admit without heſitation, that many pumices uſed by artiſts to poliſh different ſubſtances have this character; but others employed for the ſame purpoſes, and, perhaps, in equal quantities, and which no perſon has ever doubted to be pumices, have

have no ſenſible trace of filaments. Of this every one may convince himſelf by an inſpection of the pumices uſually ſold. Beſides, even thoſe that are filamentous do not conſtantly retain that character; of which the firſt ſpecies furniſhes numerous examples. Of this, large maſſes are found on the ſhore, cut by the natives into pieces for ſale; among which I have obſerved, that, though many pieces have the filamentous texture, there are many others which have it not, either externally or internally. The ſame I obſerved in many of the ſcattered pieces with which the mountain abounds. If, therefore, the filamentous texture be not a character eſſential to the pumice, I do not ſee why the ſtones of the ſecond and third ſpecies ſhould not be conſidered as true pumices, ſince they bear all the other marks by which the pumice is characterized. It may be added, that at Lipari, and in commerce, they are denominated pumices, and names adopted by the arts ought not to be changed without abſolute neceſſity.

From

From theſe obſervations, made at Campo Bianco, we begin to obtain ſome light relative to the origin of pumices, ſince we have ſeen that thoſe of the firſt and fifth ſpecies have the feltſpar for their baſe. The ſame has likewiſe been ſhewn of the others contained in the rock on which the Caſtle of Lipari is built. We ſtill, however, remain in uncertainty with reſpect to the ſecond, third, and fourth ſpecies, from their being always found in the ſtate of complete pumice, and never met with in thoſe ſtrata or maſſes of lava, which, by ſhewing the firſt principles of theſe pumices, might enable us to diſcover the ſtone from which they have originated. To attain this diſcovery, it was, therefore, neceſſary to analyze theſe three ſpecies by the humid method; and though the baſe of the firſt and fifth ſpecies, as alſo of that from the rock of the Caſtle of Lipari, was ſufficiently evident; I yet, for the greater certainty, reſolved to ſubject theſe likewiſe to the ſame analyſis; and, while employed on this operation, determined at the ſame time to make ſimilar ex-

periments

periments on ſome pumices of other countries; that, for inſtance, which is found in ſmall quantities in the Arſo in the iſland of Iſchia, and two other kinds from the iſland of Santorine in the Archipelago, a country certainly volcanic. Both the latter ſpecies are white, and float in water; but the texture of the one is compact and equable, and that of the other full of pores, and extremely filamentous.

The following are the reſults I obtained.

Firſt Species of Campo Bianco.

Silex - -	60.3
Alumine - -	23
Magneſia - -	6
Lime - -	6
Iron - -	3

Second Species.

Silex - -	80
Alumine - -	6
Magneſia - -	3
Lime - -	4.7
Iron - -	4.8

Third

Third Species.

Silex - -	80
Alumine - -	4
Magneſia - -	2.
Lime - -	4
Iron - -	5·3

Fourth Species.

Silex - -	84.5
Alumine - -	4
Magneſia - -	3
Lime - -	2.1
Iron - -	4.2

As this fourth ſpecies emitted a bituminous odour; before I analyzed it, I ſubjected it to diſtillation, in a ſand heat; from which I obtained a few drops of petroleum that ſwam on the water which had collected during the operation in the recipient of the retort containing the pulverized pumice.

Fifth Species.

Silex - -	61
Alumine - -	22.7

Magneſia

Magnesia - -	6
Lime - -	5.8
Iron - -	3

Pumice of the Rock of the Castle of Lipari.

Silex - -	63
Alumine - -	24
Magnesia - -	5.6
Lime - -	3
Iron - -	2

Pumice of the Arso in Ischia.

Silex - -	54
Alumine - -	26
Lime - -	3
Magnesia - -	8.2
Iron - -	7

First Pumice of Santorine.

Silex - -	66.8
Alumine - -	4.2
Magnesia -	14.7
Lime -	11
Iron -	3

Second

Second Pumice of Santorine.

Silex	-	69
Alumine	-	3
Magneſia	-	19
Lime	-	6
Iron	-	2

From theſe reſults it appears that the component principles of the firſt and fifth ſpecies of pumices of Campo Bianco, as alſo that of the rock of the Caſtle of Lipari, perfectly reſemble thoſe obtained by the analyſis of various feltſpars made by different chemiſts; among others, by Mayer, Fabroni, Heyer, Weſtrumb, and Morell.

The ſame agreement would be found in the ſecond, third, and fourth ſpecies, were it not that they contain a greater quantity of ſilex, and leſs of alumine; which, however, does not appear to me a ſufficient reaſon for excluding the feltſpar from theſe three pumices; both becauſe I know no other ſtone hitherto diſcovered, and chemically analyzed, to which theſe component

principles can be more properly referred than to the feltſpar; and becauſe, the ſpecies of that ſtone being extremely numerous, it cannot excite ſurpriſe if ſome ſhould differ a little from others, in the quantities of their conſtituent parts, which is the caſe in every kind of ſtone.

With reſpect to the pumice of the Arſo in Iſchia, it appears evident from its component principles, that its baſe is a hornſtone, from which the current of lava, likewiſe, derives its origin.

Laſtly, with regard to the two ſpecies of pumices from the volcanic Iſle of Santorine, it appears, from the analyſes adduced, that their baſe has been an aſbeſtus, or, at leaſt, ſome ſtone analogous to the aſbeſtus: of this we ſhall be convinced, if we compare theſe two analyſes with thoſe made by Bergman of different kinds of the aſbeſtus *.

* Opuſc. Phyſ. Chem. Tom. IV.

If

If we now proceed to conſider the various opinions relative to the origin of pumices, and examine them by the facts now ſtated, we ſhall certainly find that the hypotheſis of the Swediſh chemiſt, as alſo of Pott and Demeſte, that pumices originate from the aſbeſtus, is not without foundation; it is only erroneous in ſuppoſing that they are produced from that excluſively; ſince it has been ſhewn, that the baſe of the pumices of Campo Bianco, and the Rock of the Caſtle of Lipari is a feltſpar, and that of the pumices of the Arſo a hornſtone.

I foreſee, that ſome will with difficulty be perſuaded, that the pumices of any volcanoes have for their baſe either the aſbeſtus or the amianthus, ſince theſe two magneſian ſtones ar rare, and only found in ſmall quantities. But this is a miſtake; for we know, from the information of naturaliſts and travellers, that they are both found in many countries; as in the iſlands of the Archipelago, in Aſia, in Perſia, and Tartary, not to

mention Savoy, Switzerland, and Italy. It is likewiſe certain that the aſbeſtus is found in ſome countries in ſuch abundance that whole rocks are entirely compoſed of it, as in Siberia. I have ſome large pieces of aſbeſtus, with parallel fibres, of a greeniſh grey, and difficult to ſeparate, which were brought me, a few years ago, by one of my pupils, from Chiavenna, in the country of the Griſons, and taken, by himſelf, from Mount Uſchione, near his native place, which is full of this ſpecies of ſtone.

When we ſpeak of pumices with an aſbeſtine or amianthine baſe, it is always to be underſtood, that the volcanic fire which has produced them has been exceſſively powerful; ſince we know, from the experiments of D'Arcet, Sauſſure, and Ehrmann, how obſtinately theſe ſtones reſiſt the fire of the furnace when raiſed to an exceſſive degree of heat. The aſbeſtus of Chiavenna, the Genoeſe territory, Savoy, Corſica, and other countries of Europe, after I had kept them a long time in a glaſs furnace, ſtill con-

continued refractory, having only loſt their yielding conſiſtence, and their flexibility.

From the great affinity between ſome ſerpentines and the aſbeſtus, I cannot heſitate to believe, that ſhould the furnace of a volcano be ſituated among the former, they would likewiſe be converted into pumice.

I cannot, however, by any means, ſubſcribe to the opinion of Wallerius, that pumices are coal or ſchiſtus calcined; nor to that of M. Sage, that they are margaceous ſcoriæ; for, with reſpect to the former, we have ſeen that pumices are not in a ſtate of calcination, but of vitrification; and with regard to the latter, inſpection alone is ſufficient to ſhew the eſſential difference between pumices and ſcoriæ.

It now remains to ſay a word of the opinion of M. Dolomieu, who ſuppoſes pumices to originate from granite. This naturaliſt having examined with the greateſt attention the pumices found in the places

which I afterwards viſited, eſpecially thoſe that had undergone the leaſt alteration from the fire, ſince theſe are moſt likely to preſerve ſome characters of their primitive baſe, made the following obſervations:

Firſt, he found in ſome a reſidue of ordinary granite; that is, quartz, mica, and feltſpar; and remarked, that theſe three ſubſtances, which, according to him, ſerve, interchangeably, as a flux one to the other, had acquired, by the action of the fire, a ſpecies of vitrification of a middle nature between that of enamel and that of porcelain, and which might be compared to that of a fritt, ſomewhat inflated.

Secondly, he obſerved, that they gradually aſſume the fibrous and porous texture, and the other qualities of pumice; whence he concluded that the granite and granitous ſchiſtus are the primitive ſubſtances, which, by the action of the volcanic fire, paſs into the ſtate of pumice.

On

On my firſt arrival at the mountain of pumices, I was, as may be ſuppoſed, deſirous to aſcertain the truth of this diſcovery; and not being ſucceſsful the firſt time, I returned again another day; and this ſecond viſit proving as little ſatisfactory as the former, I made two others, but with the ſame ill ſucceſs. I examined with the greateſt care every corner of Campo Bianco, and every other part of Lipari where pumices are to be found; and as it was only neceſſary to have eyes to diſcover immediately theſe granitous rocks, changed more or leſs into pumices by the action of the fire, had they exiſted; I ſhall ſay, with the freedom of a philoſopher, that I was frequently tempted to believe that none were any longer to be found here, becauſe they had all been carried away by the French naturaliſt.

I do not, however, mean abſolutely to deny the truth of this diſcovery (and, indeed, how can it be doubted, when M. Dolomieu aſſerts that he has ſent to ſeveral men of learning ſpecimens of theſe granites,

which have gradually paſſed into the ſtate of pumice). It is conſequently proved that pumices, beſides having for their baſe the horn-ſtone, the aſbeſtus, and the feltſpar, likewiſe originate from the common granite. We may likewiſe add the petroſilex; ſince the pumices formerly ejected from Stromboli derive their origin from that ſtone*; and if naturaliſts were to examine the pumices of other countries, and to their local obſervations join chemical analyſis, it would perhaps not be difficult to find pumices which originate from other kinds of ſtone.

As to the pumices with a granitous baſe, it is obvious to remark that the ſubterraneous fire which produced them muſt have been extremely violent, ſince ſuch muſt be that of our furnaces to reduce the granite compoſed of feltſpar, mica, and quartz, to a homogeneous conſiſtence, ſimilar to that of perfect pumices. Sufficient proofs of this aſſertion may be found in Chap. XII.

* See Chap. XI.

Pro-

Proceeding from Campo Bianco by ſea, and coaſting the baſe of the mountain, we find the ſide lying on the left, and which is, in like manner, compoſed entirely of pumices, full of furrows and channels that take their direction to the ſea. Other leſſer mountains, which are white, becauſe they are likewiſe formed of pumices, join the principal one, Campo Bianco*. Beyond theſe riſes a mountain of another kind, called the Monte della Caſtagna, which, in the part of it deſcending to the ſea, is about a mile in extent, and in its circumference exceeds four miles. But who would believe that this mountain is entirely compoſed of enamels and glaſſes? Before I had read the excellent work of the Chevalier Dolomieu, I knew that Lipari abounds in vitrifications, and the reading of this book confirmed me ſtill more in the idea; but I was entirely ignorant that they were accumulated in ſuch immenſe quantities in one place as to form an entire mountain; and I

* See Plate IX.

feel

feel ſome pleaſure in being the firſt perſon who has announced to the world ſo extraordinary a circumſtance. I ſhall proceed, therefore, to conſider theſe products; firſt, as they appear on the ſpot, and afterwards divide them into their ſpecies and principal varieties.

I know not to what a tract of theſe vitrified ſubſtances can be more properly compared, than to a large river, which, breaking into a thouſand ſtreams, daſhes from height to height down a ſteep precipice, and, ſuddenly congealed by exceſſive cold, freezes, breaking every where into clefts and fiſſures, ſo that the precipice appears covered with a rough wavy ice, divided into large flakes. Such is the appearance of ſome of theſe vitrifications on the back of the Monte della Caſtagna; but ſeen from the ſhore they have a different aſpect. In the places where the waves of the ſea have produced deep excavations, we perceive that, under this vitreous ſtratum, divided into flakes or plates, there are other

ſtrata,

ſtrata, and beneath them others, all equally vitreous, but differing in colour, conſiſtence, and direction. Beneath theſe there may, likewiſe, poſſibly, be others concealed from the eye by thoſe above them. The thickneſs of theſe ſtrata is different; that of the uppermoſt in ſome places is not more than a foot and a half, but in others twelve feet. As it is higher than the others, it has not ſuffered ſo much from the daſhing of the waves, except in its loweſt parts. The higher have flowed over the rock, taking from it their configuration. Theſe vitreous bodies, having in them numerous fiſſures and clefts, are eaſily broken by the beating of the waves, and detached pieces of them are therefore found in great quantities on the ſhore and under the water, but more or leſs rounded by the daſhing of the ſea, and entirely reſembling thoſe ſmooth irregular ſtones which form the beds of rivers.

I ſhall now proceed to deſcribe the different qualities of the vitrified ſubſtances that compoſe

compoſe the Monte della Caſtagna; in which deſcription it will be impoſſible to be very brief, on account of the numerous varieties of thoſe ſubſtances, and the diſtinct attention which each juſtly claims.

I. And ſince the nature and qualities of pumices was the laſt ſubject that engaged our attention, I ſhall begin with a ſubſtance which may be conſidered as the point of tranſition of theſe bodies into glaſs. Not that it is not a true glaſs; but it is ſo light, that, like many pumices, it will ſwim in water, and poſſeſſes that fragility which always accompanies pumices. Hence it eaſily ſhivers when ſtruck againſt ſteel, and rarely emits ſparks. It has, beſides, in more than one part, ſmall pores, interrupted by vitreous threads, which is obſervable in many of theſe kind of ſtones. The vitrification is more advanced than in the pumices. The glaſs is of a whitiſh-grey, tranſparent, in part ſcaly, and in part involuted and contorted, from the number of pores which interrupt the direction of the ſtruc-

ture. It is found in detached pieces, on the ſides of the mountain; and ſome float in the ſea, the ſport of the waves.

II. This ſecond glaſs reſembles the former in more than one quality; but it is ſomewhat more heavy, and what I ſhould call reticulated, as it contains ſmall eyes, or ſpots, which give it the appearance of a net. It is found in ſtrata above ſtrata, and the face of every ſtratum is covered with an earthy and half-pulverous coating, in conſequence of which coating it eaſily ſplits.

III. Capillary glaſs, or glaſs reduced by fuſion to the fineneſs of a hair, is ſo rare in volcanized countries, that only four ſpecimens of it are known to thoſe who have moſt diligently examined the productions of ſubterranean fires. The firſt of theſe was produced by an eruption in the Iſle of Bouroon in 1766, the ſecond by Veſuvius in 1779, the third by Vulcano in 1774, and diſcovered by the Chevalier Dolomieu; and the fourth noticed by M. Faujas, who

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in the cavity of a baſaltic lava, brought by Beſſon from the volcanic caves of St. Sebaſtian at Rome, obſerved a great number of capillary filaments from three to four lines in length, of a tranſparent and vitreous ſubſtance.

The Monte della Caſtagna at Lipari furniſhes a great quantity of this capillary glaſs, which I ſhall conſider as the third ſpecies of the ſubſtances that now claim our attention. Several of theſe glaſſes, which have a very thin texture, and are conſequently very light, if they are examined internally, uſually abound with cracks, ſometimes extending from one end to the other of the pieces; and when ſtruck in the direction of theſe they are eaſily ſplit. In theſe vacuities, the glaſs is extremely ſmall and thin; in many places as fine as a hair, and forms minute entangled filaments, reſembling the fineſt wool, or thin threads tending all the ſame way. Some of the latter are ſo fine, that only breathing on them will put them in motion, and break them. They are tranſparent, and have a luſtre

luſtre like ſilver. Many of them are two inches long; and beſides thoſe which are viſible to the naked eye, there are others in great numbers which are only diſcoverable by the lens. The nature of their formation does not appear to me difficult to explain, as it probably is to be attributed to the viſcoſity of the glaſs when in a liquid ſtate, and the diſtenſion which took place from the enlargement of the apertures by congelation.

Theſe thick groups of vitreous threads, when viewed by the leſs experienced obſerver, might lead him to believe that they are a ſpecies of extremely fine pumice; but a moment's attentive obſervation will be ſufficient to diſcover the difference, which, as it is eſſential, I ſhall here ſtate.

One of the ſenſible characters of pumices, at leaſt of the greater part, is their being vitreous; but their vitrification is always in ſome degree leſs than that of the true volcanic glaſs. The filaments, however, of which I have juſt ſpoken, are entirely vi-

treous.

treous. In fact, they have the tranſparency of glaſs, and are ſmooth to the touch like that; whereas, thoſe of pumices are almoſt opake, and rough to the touch. The latter may be ſafely preſſed with the finger; but the former, though thicker, enter the ſkin, and draw blood, as may be expected from the points and ſharp edges of glaſs. It is true, many pumices have their original baſe the ſame with the volcanic glaſſes; but the action of the fire has not been the ſame on both, but on the glaſs has either been ſtronger or longer continued.

Though this ſeems ſo clear in itſelf as to need no proof, I ſhall yet produce one which is extremely obvious on the compariſon of ſome light filamentous pumices of Campo Bianco and the preſent glaſs. Both theſe bodies contain cryſtallized felt-ſpars of the ſame ſpecies, which in the pumices appear to have ſuffered no injury from the fire, as they retain their changeable luſtre, their laminated ſtructure, their natural tranſparency and hardneſs. On the contrary,

contrary, in the glaſs in which we find theſe capillary filaments, though they have not undergone fuſion, they are ſo changed that they have loſt all the characters above mentioned; and, when touched with the finger, fall into ſmall pieces, the larger only retaining a kind of central point of the original nature of the ſtone. I have in my poſſeſſion one of theſe feltſpars, which preſents a curious appearance. It is placed within one of theſe apertures, but without touching the ſides, and is, as it were, ſuſtained in the air by a crown of capillary threads of glaſs that are attached to it at one extremity, and, at the other, faſtened to the ſides of the aperture. The feltſpar muſt, no doubt, have been originally confined in the glaſs when it was fluid; but this drawing back at the time of its congelation, formed the cavity, and left the feltſpar as it were iſolated, and communicating only with that part of the capillary down, which is a part of the glaſs itſelf reduced to threads by the retiring of the ſides of the cavity. This feltſpar, which is four lines in length, and three

in breadth, is changed equally with the reſt, by the fire.

From the facts now adduced, it is evident, that the fire which produced theſe pumices was leſs powerful in its effects than that from which the glaſs derives its origin; it is not, therefore, ſurpriſing that the latter ſhould be more perfect than the former.

I have entered into theſe minute details relative to pumices and glaſſes, becauſe it appears to me that the modifications and gradations viſible in the operations of nature deſerve the moſt careful attention of the philoſopher, as, otherwiſe, by conſidering things too generally, we ſhould incur the danger of confounding objects very different in themſelves; as for inſtance, not to wander from our ſubject, ſince pumices enamels, and glaſſes are vitrified ſubſtances, we might confound them together, and even not diſtinguiſh them from lavas; and, in fact, there have not been wanting eminent writers who have characterized theſe alſo as true vitrifications.

This

This remark leads me to make a few ſtrictures on an opinion of M. Dolomieu; who having obſerved that pumice ſometimes changes into glaſs, imagined that this glaſs, by an inflation of the internal air, might paſs into the ſtate of pumice. The former I readily admit, having adduced more than one example of it in volcanic products, not to mention artificial fuſions in which I have always obſerved this tranſition of pumices into glaſſes or enamels, which is, beſides, extremely natural; the ſtone thus paſſing, by the action of a ſtrong heat, from a leſs degree of vitrification to a greater. I find it, however, very difficult to aſſent to the latter hypotheſis, as, in that caſe, we muſt ſuppoſe that a greater, or more perfect, vitrification may paſs into one leſs perfect, which is certainly very unnatural; ſince glaſs re-melted by volcanic fire will remain in its former condition; and ſuppoſing it ſhould be inflated with aëriform gaſes, from ſolid glaſs, which it was before, it will become veſicular, but never, in my opinion, can it become pu-

mice, ſince it cannot return to that feeble degree of vitrification which characterizes that ſtone. Neither are gaſes an eſſential requiſite in the formation of pumices, ſeveral kinds of which are compact, and do not ſhew the ſlighteſt indication of theſe elaſtic fluids: beſides, many glaſſes already mentioned, and others hereafter to be enumerated, ſhew, by the bubbles with which they abound, that they have every where been penetrated by theſe fluids, without having the leaſt appearance of pumice.

IV. The glaſſes of the Monte della Caſtagna which we have hitherto conſidered, are thoſe that have a texture more or leſs porous; we will now proceed to thoſe of a compact ſtructure, of which kind is the fourth ſpecies, which may be ſaid to compoſe nearly one half of the mountain. This glaſs, if viewed ſuperficially, and as it is found on the ſpot, has rather the appearance of a red earth than a glaſs, occaſioned by a red earthy coating that inveſts the glaſs diſpoſed under it in immenſe plates; which covering,

covering, though in many places it but feebly adheres to it, ſince it may be removed by ſimply waſhing with water, in others is ſo cloſely united that it forms the laſt rind or outermoſt part of the glaſs, which induces me to believe that it is a ſuperficial decompoſition of it. Beneath this earthy coating the glaſs appears, which is extremely perfect, and as if it had juſt come out of the volcano. If we except a few pieces in which its ſtructure is ſpongy, it is extremely compact and ſolid, and therefore much heavier than either of the other three kinds. It is of an olive-colour, and tranſparent when in thin ſcales, examined by a bright light, but in the maſs it appears opake. It gives ſparks rather plentifully with ſteel. Pieces of perfect glaſs, it is well known, when broken, have their fractures ſtriated, waving, and curved. In this glaſs, ſome of the fractures are the ſame; but in general they are conchoids, like thoſe of flints. Its conſiſtence is not perfectly homogeneous, as it contains many feltſpathoſe points. Its aſpect is not lively and brilliant, like that

of glaſs, but ſomewhat unctuous and dull. From all theſe qualities this product appears to be more properly an enamel than a glaſs; unleſs we are willing to conſider it as one of thoſe volcanic bodies which conſtitute the middle ſubſtance between enamels and glaſſes.

In my deſcription of the glaſſes of Lipari, I have obſerved that ſeveral of them are interſected with veins or earthy leaves, by means of which they are eaſily divided into plates. The ſame is obſervable in the preſent glaſs, in which we find the ſame quality as in ſome marbles, which being cut in the vein may be divided without any great labour, into large ſlabs, but which break into ſmall pieces if it be attempted to divide them in any other manner. Some of the workmen who dig the pumices, and were very uſeful companions to me in my excurſions to Campo Bianco and the Monte della Caſtagna, at my requeſt, drove, with heavy hammers, an iron wedge into theſe earthy veins, and extracted from the common maſs of this

this glaſs large plates five feet long, three broad, and two in thickneſs. To the ſurface of each plate was attached a coating of hard earthy matter, which ſtill more confirmed me in the opinion I have already given, that this matter had reſiſted fuſion, and, being lighter than the fluid glaſs, had aſcended to the ſurface; a conjecture further corroborated by the artificial fuſion which I made of this glaſs retaining ſome portion of this earth, which with difficulty fuſed, though the glaſs was inflated and changed into a frothy enamel.

This glaſs ſlightly cuts the factitious glaſs; and if the cutting angle of one piece is driven with force along the ſurface of another, it produces a white and impalpable powder.

V. This ſpecies of glaſs completely deſerves that appellation, ſince it is not only the moſt perfect of all the volcanic glaſſes of the Eolian iſles, but does not in the leaſt reſpect yield to what is called the Iceland

agate, or the gallinaceous ſtone of Peru, which is ſuppoſed to have been the obſidian ſtone of the ancients. In the large pieces its colour is extremely black, and it is entirely opake; but the thin leaves are white and tranſparent. The opacity and blackneſs may be ſaid to be in the direct ratio of the thickneſs. This glaſs, which is extremely compact, is free from aëriform bubbles, and from every kind of heterogeneouſneſs. It is ſomewhat harder than the fourth ſpecies, and therefore cuts factitious glaſs more eaſily, and gives more ſparks with ſteel. Its edges are ſharp and cutting.

M. Faujas, having obtained ſome ſpecimens of the beſt glaſs of Lipari, has made ſome obſervations on it proper to be given here. He admits that this ſpecies is the ſame with that of Iceland; but he remarks, however, that it differs from it in the poliſh, which appeared to him more unctuous and leſs vitreous, beſides that in the fractures it had not that waving, ſtriated, ſcaly appearance, which is proper to the maſſes of true glaſs.

It

It muſt be remembered, however, that the ſpecimens of M. Faujas were none of the beſt: the pieces, at leaſt, which I collected, took ſo exquiſite a poliſh and luſtre, that I do not believe any kind of artificial glaſs ever received one more beautiful and brilliant. This glaſs, beſides, when in the maſs, being opake, became a true mirror; and I therefore find no difficulty in believing that the ancient Peruvians uſed a ſimilar kind of glaſs, cut and poliſhed, for mirrors. This glaſs, likewiſe, could not be broken without exhibiting the undulating ſcales, lightly ſtriated, which the French Vulcaniſt affirms he could not find in his ſpecimens. While I now write, I have before me a piece, with a recent fracture, in which theſe waves are circular and concentrical, occupying an area of two inches and a half, the common centre of which is the point that received the blow: they reſemble in ſome manner thoſe waves which a ſtone produces round it when it falls perpendicularly into a ſtanding water.

I cannot

I cannot omit another remark. M. Faujas ſays, that the edges of this glaſs, where they are very thin, if preſented to a ſtrong light, are a little tranſparent. The tranſparency of the thinneſt parts of the glaſs on which I made my obſervations, when compared to that of common factitious glaſs, is certainly not equal to it: it is not, however, ſo much inferior as this naturaliſt ſeems to ſuppoſe. A ſcale three lines and a half in thickneſs being preſented to the flame of a candle afforded, in part, a paſſage to the light; and another, two lines thick, being interpoſed between the eye and external objects, permitted a confuſed ſight of them. Another, half a line in thickneſs, being laid on a book, it might be read with the greateſt diſtinctneſs. I have entered into theſe minute details the better to ſhew the perfect quality of this glaſs.

The opacity of this glaſs in the maſs proceeds from a very ſubtile, and, perhaps, bituminous ſubſtance, incorporated with the vitreous matter and rendering it dark like a cloud.

cloud. The glaſs loſes this ſubſtance if it be left for ſome hours remelted in the crucible, and it then becomes white.

Bergman obſerved that the Iſlandic glaſs, when expoſed to the fire, melts with difficulty without the addition of ſome other ſubſtance, as a flux. In this it differs from the preſent of Lipari, which ſoon begins to ſoften in the furnace, and in a few hours undergoes a complete fuſion.

This kind of glaſs, however, is not the moſt common to be met with on the Monte della Caſtagna. It is found only in a few places, ſcattered in large but ſolitary maſſes; nor can I pretend to ſay, whether theſe are remains of currents, or whether they were thrown out by the burning gulphs.

It happens to this glaſs, as to the different kinds of precious ſtones, that is, that the ſame piece is not always throughout of equal purity and value; for, on breaking ſome of theſe maſſes, we ſometimes find

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one portion very pure glaſs, ſuch as has been already deſcribed, and the other imperfect; either becauſe the fuſion has not been general, the ſubſtance containing bodies foreign to the baſe, or becauſe that baſe is rather an enamel than vitreous. Theſe bodies are feltſpars, but of a new appearance. Nothing is more common than to find feltſpars in lavas, and ſometimes even in enamels and glaſſes; of which we have frequent examples in this work, as well as in the accounts of other writers. But theſe feltſpars are always inſerted immediately into theſe ſubſtances without any intervening body. Here, however, the caſe is different: every feltſpar is ſurrounded with a rind or coating, which, when it is extracted entire from the enamel, appears to be a vitreous globule, about one or two lines in diameter, of a clear cinereous colour. If we break this globule, we find within it the half-fuſed feltſpar, not diveſted of its coating, but forming one body with it. Theſe globules are very numerous, and ſometimes by their confluence form groups; and they

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are very distinctly visible, on account of the black colour of the enamel.

The manner in which this coating was formed around the feltspars, I conceive to be as follows: When the enamel was fluid, and enclosed the feltspars, it acted as a flux to their external parts, and combined with them; and from this combination was the rind or coating produced, while the internal part of the feltspars had only undergone a semi-fusion, because it was not in immediate contact with the enamel. There can be little doubt but that the feltspars likewise existed in the perfect glass; but the heat probably being more active in that than in the enamel, they were completely dissolved, and the entire mass reduced to one similar consistence. As a proof of this conjecture, the furnace produced a complete homogeneity of parts in the enamel containing these extraneous globules.

VI. When treating of the rocks of the Castle of Lipari, I said they were formed of

a cinereous lava of a feltſpar baſe, which in many places has paſſed into glaſs. I, likewiſe, remarked that the lava, as well as the large pieces of glaſs, was filled with globules apparently not diſſimilar to the baſe. At the beginning of the Monte della Caſtagna, not far from a cottage, the habitation of one of the labourers who dig pumice, there is a current of ſimilar glaſs that falls into the ſea in ſeveral branches, and which I ſhall here conſider as the ſixth ſpecies. This glaſs, however, has a more fine and ſhining grain, and its fracture is exactly ſuch as we obſerve in glaſs; yet in beauty it is little inferior to the fifth kind; and if whiteneſs, or, more properly, the want of colour, is particularly valuable in volcanic glaſſes (ſince thoſe which have this quality are extremely rare), this, certainly, has conſiderable claim to our attention. Not that it is entirely colourleſs, as it contains a kind of obſcure cloud, which gives it, when viewed in the maſs, a blackiſh hue; but at the edges it appears white. The round cinereous bodies with which it is filled, form

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the moſt pleaſing and conſpicuous contraſt, and render the glaſs irregularly ſpotted. I have large pieces of the fifth ſort cut and poliſhed. Their colour, which is that of pitch, gives them a peculiar beauty. The blackeſt and choiceſt marbles of Varenna and Verona are far inferior to them in fineneſs of grain and luſtre; yet, from their uniformity of colour, they are leſs beautiful than this ſpotted glaſs, when it has received a delicate poliſh from the hands of the artiſt. On the ſhore, where the torrent fell into the ſea, we find pieces of all ſizes, rounded and ſmoothed by the continual agitation of the ſea; I have met with more than one of half a foot and a foot in diameter. Notwithſtanding the powerful action of the waves, which have beaten on them for ſo long a time, their internal parts are not injured, and, when cut and poliſhed, they preſent ſurfaces very beautiful to the eye. Tablets of this kind of glaſs (and there is no want of pieces of a proper ſize to form them) would add much to the grandeur and ſplendour of any ſumptuous gallery.

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But diſregarding the beauty which delights the eye, let us proceed to objects that attract and intereſt the curioſity of the philoſophical enquirer. We ſhall find that the cinereous bodies included in this glaſs are only points of lava with a feltſpar baſe; and on examining, in various places, the current of this glaſs, we ſhall perceive that it is a continuation of the ſame lava with the feltſpar baſe, of which theſe orbicular corpuſcles are compoſed; whence we ſhall not heſitate to conclude, that from this ſtone, both the lava and the glaſs derive their origin, and that we find ſmall particles of lava ſcattered through the latter, becauſe it has not undergone complete fuſion; whence we find ſome pieces compoſed partly of glaſs and partly of this ſame lava. In ſome of theſe pieces we diſcover ſmall geodes, or thin filaments of an extremely brilliant and tranſparent glaſs reſembling in miniature the huſk of the cheſnut.

VII. Though this glaſs in many particulars reſembles the laſt ſpecies, it yet differs from it in others. It is perfect like that; but

but it is of a deeper colour. In it, likewiſe, the ſmall globules abound; but they are earthy, and pulverizable; every one is detached in its diſtinct niche, or at moſt is only faſtened to it by a few points.

The deſcription of this ſeventh ſpecies of glaſs will render that of ſeveral others unneceſſary, ſince the glaſſes I ſhould have to deſcribe contain a greater or leſs number of ſimilar globules, differing only in the nature of the baſe incloſing them, which in ſome is more, and in others leſs vitreous. I ſhall only make one obſervation, which I think to be of ſome importance, relative to the glaſſes I here omit. Several of them have, even in their internal parts, fiſſures frequently an inch in breadth and three inches in length. Theſe are not entirely vacuities, but are frequently croſſed by ſmall threads of glaſs connected at their two extremities with the ſides. The broadeſt of theſe threads are four lines in breadth, and the narroweſt ſcarcely a line. When broken they have the fragility of glaſs, and are

found to be a moſt perfect glaſs, being colourleſs, and extremely tranſparent. It is eaſy to conceive that theſe threads have been formed in the ſame manner with thoſe of the capillary glaſs found in ſimilar fiſſures in the third ſpecies of glaſs.

VIII. The eighth and laſt kind of the vitrifications of the Monte della Caſtagna, may be denominated an enamel that has the colour and luſtre of aſphaltum, of a ſcaly grain, a very ſmall degree of tranſparency in the points of the fractures, and of conſiderable weight and compactneſs, though it is extremely friable. It is found in ſolitary maſſes, not very numerous, and the broken pieces have the property of aſſuming a globoſe form. Some of theſe globes reſemble thoſe found by M. Dolomieu in the iſland of Ponza. I have been favoured with two of the latter by the Abbé Fortis; but I find, that, excepting their globoſe figure, they differ in every reſpect from thoſe of which I now ſpeak. The globes of Ponza are compoſed of leaves over leaves,

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of an imperfect enamel, do not give ſparks with ſteel, and contain feltſpars and mica; whereas thoſe of the Monte della Caſtagna rarely include a few feltſpars, give ſparks with ſteel, have a vitreous appearance, and are not compoſed of plates or leaves.

Some pieces of this enamel, broken and detached from the maſſes, are in one part true enamel, and, in another, lava. The latter gives few ſparks with ſteel, has a grain approaching to earthy, and, as far as I could diſcover, has for its baſe a ſoft horn-ſtone, from which, conſequently, the enamel, likewiſe, derives its origin.

Theſe are the principal vitrifications I obſerved in my excurſions to the Monte della Caſtagna. Some I have omitted to notice, ſince, ſome trifling differences excepted, they are eſſentially the ſame with thoſe deſcribed. It is proper, however, to remark, that more than one of them exhibits manifeſt ſigns of having once flowed down the ſides of the mountain, in

the thick threads and vitreous filaments they contain, similar to thoſe we ſee, on a leſſer ſcale, in glaſs fuſed in our furnaces, when it comes into contact with the cold air, as it flows down an inclined plane.

Every one of theſe eight kinds of glaſſes and enamels may be completely re-melted in the furnace. When ſpeaking of the compact glaſs of the Rock of the Caſtle of Lipari, I remarked its extraordinary inflation in the furnace, and ſaid that this tumefaction uſually accompanies a re-fuſion, in our fires, of ſolid glaſſes, and volcanic enamels. I then had in view thoſe of the Monte della Caſtagna, five of which, though compact and ſolid, in the furnace, ſwelled high above the edges, notwithſtanding that, before their re-fuſion, they only filled a third part of it. In the deſcription of other glaſſes of Lipari, I ſhall have occaſion again to remark the ſame phenomenon, on which I ſhall make further obſervations in another part of this work.

Let

Let us now proceed to conſider the moſt remarkable lavas of the ſame place, which have an immediate relation with the glaſſes and enamels, from bearing ſome characteriſtic impreſs of vitrification. I then flatter myſelf I ſhall have given a ſufficient detail of the volcanic products of this famous mountain.

The firſt ſpecies I ſhall deſcribe has for its baſe the petroſilex; is hard and compact, and proportionably heavy, of a ſiliceous aſpect, of a pale blue colour, giving ſparks with ſteel, and abounding in black, rhomboidal, well-preſerved ſhoerls. When it was in a ſtate of fluidity, it encloſed within it ſeveral bodies of a different nature from itſelf; which being angular, and having ſharp edges, ſhew that at the time they were included in it they were not in actual fuſion. Their colour, which is that of baked brick, their numerous fiſſures, and their fragility, incline me to believe that they have been calcined, probably when they were taken up by the current.

This lava is ſpotted, and, in many places, even veined, with a black and opake enamel, harder than itſelf, but which gives but few ſparks with ſteel. Its aſpect is between the ſiliceous and the vitreous, and it has great compactneſs. The ſhoerls it contains are unaltered. This lava is diſpoſed in ſtrata, and extends a conſiderable way in ſome of the hollows of the mountain.

The extreme blackneſs and homogeneity of the enamel into which this lava is changed in the furnace, prevents the eye, at the firſt view, from diſcerning the ſhoerls it contains; but they are diſcoverable with the lens. They have loſt their cryſtallization, and have aſſumed a globoſe figure, a certain mark of fuſion, and their black colour is tinged with a dead green. The refuſion ſhews that this lava contains a number of feltſpar ſcales, which I at firſt could not diſcern even with the aid of the lens. Their white and ſomewhat changeable colour renders them viſible on the extremely black ground of the remelted enamel.

The

The ſecond lava is of a feltſpar baſe, partly white, and partly of a reddiſh yellow: it has a lucid grain, and includes amorphous feltſpars, unequally diſtributed, being rare in ſome parts and abounding in others. In many places, it is a true glaſs, diſtributed in ſmall maſſes of various colours, ſome black, others cinereous, and others white: the latter is as tranſparent as factitious glaſs.

This lava is rather rare; at leaſt I only met with two pieces of it, about the middle of the mountain; and from their angles and fractures I judged that they had been detached from ſome larger maſs.

It is one of the very few kinds which melt with difficulty in the furnace; but it is at length reduced to a black porous enamel, but without the fuſion of the feltſpars.

The third lava is of a grey colour, hard, compact, heavy, rough to the touch, and granulous. It has for its baſe the petro-

ſilex, and gives vivid ſparks ſo copiouſly with ſteel that it may ſupply the place of flint. When viewed in the dark by the light of a candle, it ſhines ſo brightly in a number of points, that, at firſt ſight, we might be induced to believe that it was full of ſmall cryſtallized and extremely brilliant zeolites, or little lucid ſhoerls; but on more attentive examination we diſcover, eſpecially in the recent fractures, that theſe points are only ſmall particles of glaſs, ſcattered in great abundance through its whole ſubſtance.

On one ſide of the Monte della Caſtagna there are prodigious maſſes of this lava, but in detached pieces, which leave us in uncertainty with reſpect to its origin.

In the furnace, this lava produces a black homogeneous enamel, compact, and ſlightly tranſparent in thoſe parts of the edges which are thinneſt.

The fourth ſpecies has a feltſpathoſe baſe, and likewiſe contains a number of vitreous particles,

particles, but which approach rather to the nature of enamel than to that of glaſs.

As this lava is extremely white, we might at firſt be induced to ſuſpect that it has been decompoſed by ſulphureous acids; an opinion which its friability appears to confirm. But there is more than one reaſon to convince us of the contrary. Firſt, the injury which this lava had received from theſe acids would have extended to the enamel, as I have ſhewn that the enamels and vitrifications of Vulcano are ſenſibly altered by theſe volatile ſalts, whereas the preſent enamel is not at all affected. *Secondly*, as theſe vapours act on the ſurface of volcanic productions, the decompoſition and whiteneſs do not uſually enter very deep into them; and the nucleus of theſe products retains its colour and primitive compactneſs. An example of this we have already noticed in the lavas of Solfatara and its environs *; and we ſhall ſoon have occaſion to mention

* See Chap. II.

another

another in thoſe of Lipari, not far from the Stoves, or hot baths. The preſent lava, however, which is in detached pieces, many feet in thickneſs, has the ſame whiteneſs and friability on its ſurface and in its moſt internal parts. Laſtly, theſe vapours, in decompoſing volcanic products, take away the roughneſs of the parts, and render the ſurface ſmooth and more or leſs ſoft to the touch; but this lava retains the ſame roughneſs in every part. I muſt here add, that, in all my reſearches about the Monte della Caſtagna, I have not found any part of it which ſhews ſigns of the influence of theſe ſulphureous vapours.

The furnace, in a few hours, reduces this lava into a groſs enamel, of little adheſion, and of which many parts are not vitrified; but, in a longer time, it paſſes into a true homogeneous and extremely porous glaſs.

The fifth and laſt lava may be conſidered in many different points of view, each of which deſerves to be diſtinctly noticed; the

fire

fire and elaſtic fluids having produced very different qualities in the ſame product. The following are the principal:

If we break a maſs of this lava into ſeveral pieces, we ſhall find that ſome of them have many cracks or fiſſures; ſome extending lengthwiſe, and which ſeem to have been produced by the retiring of the parts on congelation, and others of a roundiſh form, probably the effect of the action of the elaſtic gaſes. Theſe fiſſures are ſurrounded with fibres, knotted and twiſted in a thouſand ways, and reſembling thoſe found in the cavities of ſome kinds of pumice; except that the fibres of the latter, the fineſt at leaſt, have the luſtre and colour of ſilver, whereas the ſeare of a dark grey, and a ſtructure not at all vitreous.

Other pieces of the ſame lava have not theſe fiſſures, and differ from the former likewiſe in other reſpects. Thoſe before deſcribed are light, and have a ſponginess ſimilar to that of ſome burnt bones, as alſo

great friability; whereas, on the contrary, these are compact, hard, heavy, and contain small and shining particles of glass.

Others instead of these particles or points have a vitreous ground, but scattered over with small globules of lava.

Lastly, others have passed into glass which would be very perfect were it not mixed with the above-mentioned globules.

The colour of this lava, where there are no vitreous parts, is cinereous; and its base, as far as I can discover, horn-stone. In the furnace it produces a scoriaceous enamel.

Having thus described the principal volcanic products of Campo Bianco and the Monte della Castagna, which are pumices, glasses, enamels, and lavas, more or less vitreous, I shall here make a few remarks, before I proceed to describe the other objects that drew my attention on the remaining parts of the shores of the island.

Though

Though Campo Bianco and the Monte della Caſtagna are conſidered as two diſtinct mountains, they are ſo connected together and continued that they may very juſtly be eſteemed only one; or at leaſt as forming a ſingle group in the iſland. The identity of the products in both, confirms in ſome meaſure the unity of this group. In the part abounding with pumices, we meet, at every ſtep, with detached pieces of glaſs, and on the Monte della Caſtagna amid the glaſſes we find numerous pumices; a part of the ſolid kinds of which are dug here after removing the maſſes of glaſs under which they are buried.

It is further to be obſerved, that though this mountainous group when ſeen from the ſea appears iſolated, yet, on aſcending to the ſummit, we find that it extends far to the weſt, as we ſhall perceive more diſtinctly when we come to treat of the Stoves of Lipari. I believe, therefore, I ſhould not exaggerate were I to ſay that this group of mountains, taken in its whole extent, has a

circuit of eight miles; nor is the extent of its vitrifications leſs, if in theſe we include likewiſe the pumices, which are, in fact, only a leſs perfect glaſs.

But how much more extenſive, on the ſide of the ſea, muſt have been this tract of vitrified ſubſtances in the ages immediately following the formation of the iſland! We have already ſeen how the rain-waters, that drain toward the ſea from the ſummit of Campo Bianco, have deeply corroded and furrowed its declivity. The ravages which the waves of the ſea have made, and are continually making, have already been deſcribed, and are ſufficiently proved by the heaps of pumices fallen along the ſhore, and thoſe which float on the waves at the foot of Campo Bianco; for neither a north nor a north-eaſt wind can blow without a prodigious quantity of theſe light ſtones being wafted into the harbour of Lipari.

The devaſtations which the vitreous mountain della Caſtagna has ſuffered and is daily

daily ſuffering on the ſide beaten by the ſea, are likewiſe very great. That theſe have formerly been very conſiderable, is proved by the ſmall vitreous rocks within the ſea, which there is no doubt anciently formed one whole with the mountain, and have been ſeparated from it by the corroſion and deſtruction of the intervening glaſſes.

In this extenſive group of mountains and their environs, we find no characteriſtic marks of the exiſtence of ancient craters. It is true that in ſeveral places we find cavities that approach to a round form; but they leave us in abſolute uncertainty whether they have been mouths of volcanos, ſince we meet with ſimilar ones, and much more ſpecious, in countries not volcanized. It cannot, however, be doubted, that Campo Bianco and the Monte della Caſtagna are the produce of ſucceſſive eruptions, ſome of which have formed currents, and others been thrown into the air. Of the former we have ſeen many proofs both in the pumices

mices and the glaſſes; and the detached and ſolitary pieces of theſe ſame ſubſtances are ſufficient evidence of the latter.

With reſpect to the glaſſes, beſides thoſe which are ſcattered ſolitarily on the Monte della Caſtagna, we meet with them diſperſed in like manner on Campo Bianco. The ejections of theſe ſubſtances from the volcanos have likewiſe extended beyond theſe places, as I began to find them ſcattered among the lavas before I arrived at Campo Bianco. We have alſo ſeen that ſome kinds of the pumices bear evident marks of having been thrown into the air from the volcanic gulphs. This I now judge to have been the origin of the pulverized pumice with which Campo Bianco abounds. I at firſt imagined it was to be attributed to the ſuperficial corroſion of the rain-water, and the influence of the atmoſphere; but in more than one deep excavation made on the ſpot, where either the rains have not penetrated, or, if they have, muſt have been unable to corrode,

corrode, from want of impetus, I found the ſame abundance of pulverized pumice: I am therefore of opinion, this muſt have been thrown out by the ſame volcano that ejected the pumices. Such, in fact, is the conſtant effect obſervable in burning mountains; which, when they eject lavas and other ignited bodies, throw out, at the ſame time, clouds of aſhes, which, when attentively examined, are found to be only a mixture of ſmall particles of the larger bodies ejected. I have made the ſame obſervation relative to the fiery ſhowers of Veſuvius and the ejections of Stromboli.

We have ſeen that the primordial rocks, which, by their liquefaction, have given birth to Campo Bianco, the Monte della Caſtagna, and the vaſt rock on which the caſtle of the iſland ſtands, were for the moſt part feltſpar or petroſilex, ſometimes converted into pumices, ſometimes into glaſſes and enamels, and ſometimes into mixed lavas containing more or leſs vitreous parts. In deſcribing theſe vitreous parts, and the

large maſſes of glaſs that are a continuation of the lavas, I have not attempted to determine whether it has been the conſequence of a more vehement heat, that the lava has in ſome places been changed into glaſs, or becauſe that in ſome parts it was more eaſily vitrifiable. Both opinions appear probable, and poſſibly both may be true, according to the difference of circumſtances. Where a lava retains the nature of lava for ſome extent, and then changes into glaſs, I find no difficulty in ſuppoſing that its vitrification has been the conſequence of a more intenſe heat: but wherever large maſſes of lava exhibit points of glaſs, not only externally, but even deep in their interior parts, it does not ſeem very natural to ſuppoſe that theſe can have been the effect of a ſtronger action of the fire upon thoſe points of the lava; they muſt rather be aſcribed to a greater aptitude in the lava itſelf to vitrify in thoſe parts.

And here an opportunity preſents itſelf to mention an appearance I obſerved, which certainly

certainly merits ſome attention. In making the circuit of the ſides of Campo Bianco, and the Monte della Caſtagna, I ſometimes met with iſolated maſſes which any perſon without the leaſt doubt would have pronounced to be glaſs, as in fact they were externally, this glaſs inclining to a yellow or blue colour, being very ſmooth, and promiſing to prove extremely fine. But on breaking one of them it was found to be a pure and ſimple lava, coated with a ſlight varniſh of glaſs, like the glazing of an earthen veſſel. I at firſt imagined that the heat had acted more powerfully on the ſurface of theſe lavas when fluid, than on their internal parts: but a further examination convinced me this ſuppoſition was ill founded; for more than one of theſe maſſes were angular, and in ſome places diſcovered old fractures which ſometimes had a conchoidal figure. I could alſo, ſometimes, join two pieces together in ſuch a manner as to prove that they had once formed a larger whole. In theſe caſes the vitreous varniſh, which was about the thickneſs of 1-6th of a line,

was eqully extended over the angles, the fractures, and even the ſurfaces by which the two pieces might be ſo exactly joined. It was impoſſible, therefore, not to conclude that this varniſh had been produced poſterior to the action of the fire. But by what cauſe? I candidly confeſs I know not: I can only ſay, that on examining volcanic glaſſes on the ſpot I have found that ſome of them, in the parts moſt expoſed to the action of the atmoſphere, and the elements, have contracted a kind of opal-appearance, extremely agreeable to the eye, but entirely ſuperficial. May not the ſame cauſe, whatever it be, which gives this pleaſing poliſh to glaſs, by acting on the lava, cover it with a vitreous varniſh? I ſhall not, however, venture to determine any thing poſitively.

I ſhall conclude my obſervations on theſe places with ſome remarks on the univerſal ſterility that reigns through them, though their origin is anterior to the records of hiſtory. If we except a few lichens attached to the fiſſures of the glaſſes, there is no veſtige

veſtige of a ſingle living vegetable over the whole Monte della Caſtagna; and on Campo Bianco, as has before been ſaid, they are extremely rare. This ſterility is a conſequence of the vitreous nature of the mountain, which, in ſo many ages, has not been decompoſed into a vegetable earth, and, according to every appearance, will continue the ſame for a long ſeries of centuries to come. Among all volcanic products, the vitrified ſubſtances are the moſt refractory to the changes of the atmoſphere and the action of the humid elements. This ſimple obſervation may teach us how uncertain are all attempts to determine the epochs of the flowing of lavas from the greater or leſs change they may have ſuffered from the influence of the atmoſphere combined with that of other deſtructive agents; the degree of ſuch alteration depending on the nature of the lava itſelf, according as it may be more or leſs earthy, or more or leſs vitreous. We may, indeed, with the utmoſt reaſon, aſcribe an antiquity almoſt tranſcending our conception, to a volcanic glaſs, or a vitreous

lava, which ſhall naturally have been reduced to an earthy ſoil, proper for the production and nouriſhment of plants.

The abundance of the objects preſented by this ſide of the iſland of Lipari, has compelled us to be ſomewhat diffuſe; but this it was impoſſible to avoid, without failing in accuracy. This prolixity will, however, be compenſated, by the brevity with which the other productions of the baſe of the iſland may be deſcribed; ſince, though we have ſcarcely examined more than a third part, the remainder offer only a few facts deſerving obſervation.

Beyond the pumices, the lavas again appear, beginning from the *Punta del Segno Nero*, and extending in a chain of ſeveral miles, which on the ſide of the ſea deſcends in preciſpices and craggy declivities. Theſe lavas, with reſpect to their compoſition, will not greatly attract the attention of the Volcaniſt, ſince in that they do not differ from thoſe of other volcanos; they will only ex-

cite his notice for their currents, which in ſome places deſcend ſeparately, and in others interſect, and paſs over each other. For the extent of three miles they do not appear to have ſuffered any alteration but that which is the effect of the atmoſphere, and which in them is extremely ſmall; but when we arrive oppoſite to Saline, and tack the boat towards the Straight of Vulcano, we find them all more or leſs decompoſed by ſulphureous acid fumes. They preſent a highly varied ſcenery, from the diverſity of colours they exhibit; among which the red and white are moſt conſpicuous. On a nearer examination they are found ſoft, and ſome of them pulverizable; but the decompoſition only reaches to a ſmall depth; theſe lavas ſtill preſerving, in their internal parts, their hard grain, and natural compactneſs. Several of them are covered with a cruſt of ſulphate of lime (ſelenite).

The lavas thus changed by the action of theſe ſalts, extend only from the ſea-ſhore to

the part oppoſite Vulcano; leaving, however, ſome intervening vacancies. Such is that denominated La Grotta della Signora, formed by a ſpacious incurvation of the ſhore hollowed out of the lava, which may be termed a breccia, ſince it is compoſed of a number of angular and irregular pieces of lava of a petroſiliceous baſe, united together, and which, not being extremely ſolid, has eaſily been broken and excavated by the action of the waves.

Proceeding farther, we find the ſea make an incurvature, and form a ſmall bay called the Valle di Muria, which, from the intereſting objects it preſents, merits to be ſomewhat particularly deſcribed. On its ſides riſe high and ſteep rocks of lava, half demoliſhed, the fallen pieces of which lie in heaps on the ſhore. In ſeveral places this lava exhibits no traces of having ſuffered any alteration from the action of the ſulphureous acids; but in others a decompoſition very ſenſibly appears; nor is it wanting in incruſtations of ſulphate of lime, of a red

tinge,

tinge, though ſome remain very white. But neither in theſe places, nor in others before mentioned, do theſe fumes any longer act, no ſmell of ſulphur is perceived, nor any vapour ſeen; and it is probable that all remains of internal conflagration have long ſince been extinct.

Among theſe lavas we likewiſe find enamels and pumices. Sometimes the former are ſeparated from the latter, and ſometimes one part of the ſame piece is pumice and the other enamel. The latter is opake, of a cinereous colour, friable, of a ſcaly grain, and, as I judge, of a petroſiliceous baſe. The pumice is of the claſs of the compact and heavy, and of a filamentous grain. Both the pumices and enamels frequently contain feltſpars, though ſcarcely diſcernible, and ſome ſcales of black ſhoerls.

Both theſe bodies produce in the furnace a black enamel, with many bubbles in that afforded by the enamel, but fewer in the product of the pumice: the ſhoerls and feltſpars fuſe in both.

Among

Among theſe decompounded lavas we meet with certain curious and beautiful objects, which derive their origin, in my opinion, from filtration. Two of theſe I will deſcribe, after having given ſome idea of the lava in which they are obſerved.

This lava is white, friable to a certain depth, and manifeſtly ſhews a decompoſition by ſulphureous acids. It is of a petroſiliceous baſe, in many places diſpoſed in ſtrata; and its ſtratification is probably that of the ſtone from which it originated. It is full of ſmall cells, and other minute cavities, within which the objects I mentioned make their appearance.

The firſt of theſe conſiſts of minute cryſtallizations of ſhoerls. From the internal ſides of ſeveral of theſe cells and cavities project very ſlender ſhoerls, which form ſometimes a kind of plume, at others a fan in miniature, at others a truſs or bunch, and at others they are detached, and, when viewed with the lens, reſemble minute briſtles of a dark

dark chefnut colour. A fimilar appearance I obferved in the fiffures of a lava of Solfatara *. I am of opinion it is to be afcribed to filtration, after the hardening of the lava; fince, though it is certainly very common to find fhoerls in lavas, they are always found incorporated within them, in the fame manner as they exifted in the ftone, their original matrix, and never detached from the lava, as in the prefent cafe.

The fecond filtration has produced fmall quartzofe cryftals; and the manner in which they are diftributed in the lava, and their prodigious number, render them a very fingular phenomenon among volcanic objects. Wherever the lava is fcabrous, wherever it has folds, finuofities, cavities, or fiffures, it is full of thefe cryftallizations. The larger cryftals extend to three lines and a half in dimenfion; but thefe are extremely rare, and almoft always ill-formed. The greater part are about half a line. When we view a piece of this lava expofed to the fun, it

* See Chap. II.

fparkles

ſparkles in every part; but on a more attentive examination we diſcover the ſingle, minute, quartzoſe cryſtals, which may be diſcerned ſtill more clearly by the aid of a lens.

Theſe cryſtals generally conſiſt of an hexagonal priſm, infixed by the lower part into the lava, and, in the upper, terminated by an hexagonal pyramid, the ſides of which are for the moſt part iſoſceles triangles. The form of theſe pyramids, however, is not always the ſame, neither with reſpect to the number nor the figure of the ſides, and the ſame is to be obſerved of the priſms. Three cryſtals alone, among the great number I examined, were terminated by two pyramids: the priſm was attached to the lava in a few points, and the pyramids projected out. This kind of cryſtals is extremely brilliant, and of the firſt water. There is ſcarcely one which is not ſtreaked tranſverſely like rock cryſtals. The moſt regular are in ſmall cavities, without, however, entirely covering the ſides of them, as

is

is uſual with the geodes. Not a few of them, likewiſe, are found out of theſe cavities, in ſome parts of the lava: theſe are frequently ſhort and grouped, not without ſome confuſion of the priſms and pyramids.

The lava which is embelliſhed with theſe cryſtallizations, forms immenſe rocks, and vaſt elevations hanging over the ſea, which, wherever they are broken to a certain depth, are found to contain theſe cryſtals, accompanied by capillary ſhoerls, ſuch as have been already deſcribed; but the latter are not very numerous.

It is well known that rock cryſtals ſometimes contain within them extraneous bodies, ſuch as ſmall tufts of amianthus or aſbeſtus, metallic ſulphures, earthy particles, and even cryſtallized ſhoerls of various ſizes. I have in my poſſeſſion a group of needle-formed cryſtals, from Mount St. Gothard, within which are ſeven ſmall priſms of black and ſtriated ſhoerl. The ſame may be obſerved

ſerved in theſe minute cryſtals, relative to the capillary ſhoerls, as will appear from the following facts: Firſt, I have found in a fiſſure of the lava, a quartzoſe cryſtal, containing a group of capillary ſhoerls, in part included within it and partly projecting out. Secondly, the apex of a ſimilar group or tuft projected from one ſide of the ſame piece of lava, and buried itſelf, with extended threads, within the pyramids of three cryſtals that formed a knot. Thirdly, one cryſtal was perforated from ſide to ſide by a needle of ſhoerl, the two ends of which projected out; and many ſimilar needles projected from the ſurface of another cryſtal. I might produce many other inſtances of theſe ſports of nature equally curious; but theſe appear to me ſufficient to prove my aſſertion, as alſo another truth, which is, that the formation of theſe capillary ſhoerls muſt have preceded that of the quartzoſe cryſtals; otherwiſe it is impoſſible to conceive how the former ſhould have penetrated the ſubſtance of the latter.

I have

I have generally experienced that the decompoſition of lavas was an obſtacle to their perfect fuſion; and this was the caſe in the preſent lava. In the furnace it vitrified ſuperficially, with ſome beginning of internal fuſion; but the pieces ſtill preſerved the form they before had. Having broken ſeveral of theſe pieces, I examined the cavities, which, according to the preceding obſervations, muſt contain the cryſtals of which I have been ſpeaking. I, in fact, found them there, and, to my great ſurpriſe, perfectly unchanged; as I could not diſcern, in either the priſms or pyramids, the ſlighteſt flaw or ſcratch, and they even retained their brilliancy and tranſparency. I obſerved that ſome of them had been overflowed, if I may uſe the term, by the lava ſuperficially re-melted, to one third or a half of the priſm, and ſome of them quite to the baſe of the pyramid; but the part which roſe above the lava, was perfectly well preſerved. Very different was the caſe with the ſhoerls, which, by their melting, had left blackiſh ſpots on the lava, though in more than one

of

of theſe the traces of the ſhoerl might ſtill be diſtinguiſhed.

A third ſtone, the origin of which I likewiſe aſcribe to filtration, is a ſemi-tranſparent calcedony, of a milky whiteneſs, with a ſlightly blueiſh caſt. It is found in reniform, or kidney-ſhaped, pieces, within the lavas of the above-mentioned Valle di Muria, and ſtill more plentifully on the ſea-ſhore. The ſmalleſt are an inch in diameter, but the largeſt eight, and ſome twelve inches. There are few of them which have not knobs and cavities; the latter commonly form geodes of minute quartzoſe cryſtals, but of which little more is diſcernible than the pyramid. It is well known that calcedonies differ very much in hardneſs. The preſent are extremely hard, and, from the ſtrength and quantity of the ſparks they give with ſteel, equal the beſt flints. They will likewiſe cut factitious glaſs; but in this they do not excel the ſmall quartzoſe cryſtals produced by filtration, of which we have juſt ſpoken.

On

On breaking ſome of theſe calcedonies, one of them was found to contain two extraneous bodies; that is, a ſmall piece of lava and ſome ſulphate of lime cryſtallized; which were probably taken in by the particles of the calcedony, while in a ſtate of fluidity or ſoftneſs.

Theſe ſubſtances, which are found on and within the lavas, and are foreign to them, derive their origin, in my opinion, from their decompoſition cauſed by the ſulphureous acids, or even by the injuries of the atmoſphere. The coherence of their conſtituent parts being deſtroyed, particles of them are carried away and depoſited by the water in the cavities and fiſſures of the lavas, where, from the affinity of aggregation, they produce ſtalactitical concretions of different kinds according to their reſpective natures. If the lapidarious moiſture be a mixture of ſilex, alumine, magneſia, lime, and iron, in certain proportions, it will cryſtallize into ſhoerls; or if it be entirely or principally ſiliceous, it will produce quartz-

oſe cryſtals. If again this moiſture, in which the ſilex is ſo abundant, contain, likewiſe, a ſmall quantity of alumine, it will conſolidate into maſſes of calcedony, which will take the form of the cavities that have received the moiſture.

This latter ſtone has been diſcovered in other lavas. Such are the Vicentine, called *Enidri Vicentini*, from the drops of water which they ſometimes contain. My ſpecimens have none; but I doubt whether any have been found equal to them in ſize in volcanic countries. In ſome of them, their milky whiteneſs is interrupted by roſe-coloured ſpots; which colour is probably derived from the iron that tinged the lava before its decompoſition.

Before I conclude this Chapter, two things more remain to be mentioned, which I obſerved before I returned to the haven of Lipari, which is diſtant about three miles from the Valle di Muria.

Firſt,

First, there are two rocks within the channel of Vulcano; one nearly of a triangular ſhape, a hundred and fifty-two feet high, and twenty in breadth. It is called Pietra Lunga, and is remarkable for a kind of gate in the middle of it, through which ſmall veſſels may paſs. The other is of the ſame height, but has greater breadth, and is about two hundred paces diſtant from the former. The matter of which both are formed is the ſame; that is, a decompoſed lava, of a petroſiliceous baſe, and extremely reſembling that of the Valle di Muria, which contains the quartzoſe and ſhoerlaceous cryſtallizations; though in this none are to be found. The lavas of Lipari extending along the ſhore, in front of theſe two rocks, are partly of the ſame quality, which inclines me to believe that anciently theſe lavas formed one continued whole with the two rocks, though the former is diſtant from them two hundred and forty feet, and the latter a full mile; and, therefore, that the channel which ſeparates Vulcano from Lipari, and which is but narrow,

muſt, once, have been much narrower. I have, likewiſe, frequently obſerved, when the ſea has been perfectly calm, rocks under water, between the two above-mentioned and the ſhore of Vulcano; whence it appears to me not improbable that this iſland was formerly united to Lipari, and that the inceſſant beating of the waves has in time formed this channel or ſtrait, in the ſame manner that many other ſtraits, of much greater breadth, have been produced by the ſea.

The ſecond obſervation I had to make reſpects the appearance of Monte della Guardia as ſeen from the ſea. It there appears biſurcated, from the projecting of a much ſmaller mountain, called Monte Gallina, from its north-eaſt ſide. The roots of Monte della Guardia, on the ſouth and ſouth-eaſt ſide, are in the ſea; and ſome parts of them afford pumices, which higher up are buried under vaſt accumulations of lava that has flowed over them. Beſides the pumices, ſeveral of the [illegible]

rection of the ſouth-weſt, preſent large maſſes of glaſs, partly detached, and partly incorporated within them. If to theſe two kinds of vitrifications we add the others which lie under the Caſtle of Lipari, and on its ſides, and which make a part of the baſe of the Monte della Guardia, we ſhall perceive how much this mountain muſt have abounded in vitreous eruptions; an abundance which will appear ſtill greater when we come hereafter to conſider its more elevated parts.

Theſe are the moſt important objects which preſented themſelves to my obſervation in my excurſion round the baſe of Lipari; and if in deſcribing them I may appear to have been ſomewhat too diffuſe, their number and importance, and my deſire to give the reader an accurate idea of them, muſt be my excuſe. The interior part of the iſland, which I ſhall now proceed to conſider, will afford me an opportunity to be more conciſe.

END OF THE SECOND VOLUME.

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